A STUDY OF INJURIES TO NECK STRUCTURES IN CASES OF HANGING

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CERTIFICATE

This is to certify that the dissertation entitled, **"A STUDY OF INJURIES TO NECK STRUCTURES IN CASES OF HANGING"** submitted by **Dr. N. VIJAYAKUMARI,** in partial fulfillment for the award of the degree of Doctor of Medicine in Forensic Medicine by the Tamilnadu Dr.M.G.R. Medical University, Chennai is a bonafide record of the work done by her in the Institute of Forensic Medicine, Madras Medical College, during the academic year 2007– 2010.

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CONTENTS

INTRODUCTION

INTRODUCTION

Hanging remains to be one of the common methods of committing suicide. Homicidal and accidental hanging are rare. Hence all cases of hanging are considered as suicidal until the contrary is proved. Because of the above, postmortem suspension of the body may be resorted to mask the crime. So, a careful forensic examination is of great importance, with the aim of ascertaining the antemortem character of the lesion and also to exclude the possibility of murder dissimulation.

There is no specific gold standard to distinguish between Antemortem hanging and Postmortem hanging. However presence of :

1) Vertical salivary dribble mark from the dependant angle of mouth
2) The phenomenon of Lefacies sympathetique
3) Presence of Petechial haemorrhages
4) Hyperaemia and ecchymosis of margins of ligature mark are considered as features of antemortem hanging.

But obvious salivary dribble mark could be detected only in 56% of cases. A meticulous examination of the body right at the scene of hanging, that too, before removing the clothes and apparels can give the real prevelance of it. Lefacie sympathetique is very rare, i.e., as low as

1% as observed in different studies. Although petechial haemorrhages commonly occur in cases of antemortem hanging, they are not diagnostic of antemortem hanging and they occur in various asphyxial and nonasphyxial deaths. And it is also equally important to note that petechiae may be absent in rapid death due to vagal stimulation in hanging. So, petechial haemorrhages cannot be taken as a specific feature of antemortem hanging. Furthermore, the ligature mark, which is considered as the principal external sign of hanging, is mainly a postmortem phenomenon.

So, it is very much necessary to look for any injury to inner neck structures, that is quiet frequent than the above, which cannot be artificially produced and which also indicates ligature mark intravitality to establish the antemortem hanging.

With this point in view I have chosen this topic of “A STUDY OF INJURIES TO NECK STRUCTURES IN CASES OF HANGING”, to find out which is the most common and most reliable criteria of neck injury to say that it is an antemortem hanging.

AIM OF THE STUDY

AIM

The aim of this prospective study, done during the period of August 2008 to July 2009, at the Department of Forensic Medicine, Government General Hospital, Madras Medical College, Chennai-3, in cases of deaths due to hanging, is to determine the prevalence of neck injuries like,

1. Rupture/contusion of sternomastoid and strap musles of neck
2. Carotid intimal tear
3. Fracture of hyoid bone
4. Fracture of thyroid cartilage
5. Fracture of cricoid cartilage
6. Fracture and dislocation of cervical vertebra and

To find out, the most common and most reliable criteria of neck injury, to say, that it is an antemortem hanging.

MATERIALS AND METHODS

MATERIAL AND METHODS

This prospective study was conducted in the Institute of Forensic Medicine, at Madras Medical college and Government General Hospital, Chennai-3, from August 2008 to july 2009. Only cases in which the history and scene of crime examination report given by police and relatives of the deceased are suggestive of Antemortem hanging were included. 63 cases of deaths due to hanging, which was subjected to Medicolegal Autopsy, were the subjects of this study.

All cases with,

1. External neck injuries other than the ligature mark,
2. Other external injuries suggestive of homicide, and
3. Cases with postmortem interval of more than 24hrs to avoid artifacts of decomposition were excluded.

The information regarding identification of the deceased, reason for committing suicide, place of hanging, material used, position of the knot, type of knot, whether it was a complete or partial hanging, any blood stains or disturbance, etc., at the scene of crime, to rule out the possibility of homicide, history of any illness or drug intake, alcoholism, previous attempt of suicide, presence of suicidal note, etc were enquired

from the police and detailed interviews of the relatives of the deceased. Irrespective of the information gathered from the police records and accompanying relatives of the deceased, in all cases, both external and internal findings were observed meticulously during postmortem examination to rule out homicidal hanging or any other cause of death. Complete perusal of all the records done prior to Medicolegal Autopsy, which is a routine protocol in all cases.

After identification of the body, a careful search for any external injuries, dribbling of saliva, signs of asphyxia like bluish discoloration of fingernails, petechial haemorrhages, signs of sphincter relaxation, Le-facie symphathetic, pattern and also any distribution of hypostasis , extent of rigor mortis developed, etc are looked for. A detailed study of the Ligature mark done. Finally a meticulous dissection of neck is done by a step-by-step layer wise reflection of the tissues after the thoracic organs and the brain have been removed. This allows the blood in the neck to drain away, providing for a cleaner dissection field.

DISSECTION OF NECK:

The neck is extended by keeping a wooden block under the shoulder. With a midline incision the skin and subcutaneous tissue is reflected off the underlying anterior cervical strap muscles along the

fascial plane. The manubrium sternum is left intact at the beginning of the autopsy when the rib cage is removed so that the inferior attachments of the anterior cervical strap muscles remain unaltered. After cutting the inferior attachments of the muscles, each muscle is examined anteriorly and posteriorly for contusion or rupture and then reflected superiorly. Now the carotid sheeth is identified and opened to view the internal jugular vein and the carotid artery. With gentle dissection carotid artery is separated and dissected out on both sides from its origin till high up in the neck or few centimeters above its bifurcation. Then, it is opened by cutting it longitudinally with small scissors with blunt tips from below upwards and examined for transverse carotid intimal tears, extravasation of blood or ruptures. Now the thyroid glands are examined in situ and then removed to study the underlying tracheal rings. Reflection of the trachea towards the face will allow for the visualization of trauma to the prevertebral musculature and fascia. Next the tongue, larynx and upper trachea are removed as a whole by inserting the scalpel blade over the body of the hyoid bone and into the floor of the mouth. Then the scalpel blade is directed downward along each greater horn of the hyoid bone, cutting the pharyngeal tissues until the anterior surface of the cervical vertebrae is seen. Then gentle traction is applied to the larynx while dissecting it from rest of the neck structures. The hyoid bone, thyroid cartilage and cricoid cartilage are

separated from ligaments and soft tissues and examined for areas of blood extravasation and fracture. Cervical vertebra are examined for any fractures, dislocations with areas of extravasation. All the positive and negative findings are documented and photographed.

Blood samples taken from the left chamber of the heart and tissue samples were collected for systemic toxicological analysis according to regular procedures. All samples were sent to the Forensic Science Laboratory, Mylapore, Chennai, to determine/rule out use of drugs, poison and ethanol.

The data so obtained from detailed history, postmortem examination and chemical analysis was statistically analysed and compiled.

REVIEW OF LITERATURE

ANATOMY OF NECK

Neck is the region of the body that lies between lower margin of the mandible, mastoid process of temporal bone and superior nuchal line of occipital bone above and upper border of clavicle and suprasternal notch below. It is the major conduit between head and trunk and limbs. Many important structures are crowded together in the neck such as muscles, vessels, glands, nerves, trachea, oesophagus, larynx, vertebrae etc. Some of these structures are very important to life like thyroid gland, trachea, jugular vein, vagus nerve, vertebral arteries etc.[41,43] 'Cervix' or 'Collum' are the Latin words for neck.[21]

BONES OF NECK

There are seven cervical vertebrae and hyoid bone in the neck. Typical cervical vertebrae have small broad body, triangular vertebral foramen and bifid spine. The characteristic feature of cervical vertebrae is foramen transversarium on the transverse process which transmits vertebral artery. Third to Sixth vertebrae are typical cervical vertebrae. The first cervical vertebra is called Atlas. It is a ring shaped one without a body and spine. The second one is called Axis, having a strong tooth like process which projects upwards (dens or odontoid process) which

occupying the position of body of Atlas. The seventh vertebra is called vertebra prominence, has a long spinous process, which is not bifid and a large transverse process with a small foramen.[15, 21]

HYOID BONE

The word hyoid came from Greek word ‘hyoides’ which means “shaped like letter upsilon”. It is a U shaped bone. It lies between mandible and thyroid cartilage at the level of third cervical vertebra. It is suspended by muscles connecting it to mandible, styloid process, thyroid cartilage, manubrium and scapulae and does not articulate with any other bone. Functionally hyoid bone serves as an attachment for anterior muscles of neck and a prop to keep the airway clear. It has a body and greater and lesser horns. Body of hyoid is 2.5cm wide and 1cm thick. Each end of the body is united with greater horn that projects postero-superiorly. This union is by fibro cartilage in young people and by bone in old people. The lesser horn is a small bony projection from superior part of the body near its union with greater horn. It is connected to the body by fibrous tissue. [21, 41] (Fig.No.1)

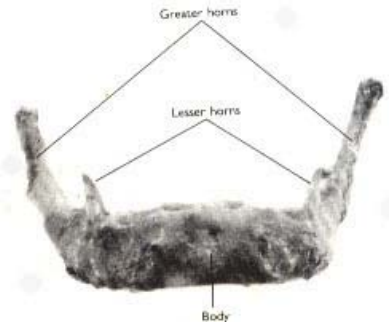


Fig. No. 1 Hyoid Bone [43]

Hyoid bone is developed from the cartilages of second and third visceral arches; lesser cornua from second arch greater horn from third arch and body is formed from the fused ventral ends of both. Chondrification of hyoid bone starts in the fifth week and completes by third and fourth month of intra uterine life. There are six secondary centres of ossification, two for the body and one for each cornu. Centre for greater horn starts at the end of intra uterine life, for body before or shortly after birth and for lesser horn around puberty. Apices of greater horn remain cartilaginous until third decade.[15]

JOINTS OF NECK

Typical cervical joints are between lower six cervical vertebrae. Here the supraspinous ligament is replaced by ligamentum nuchae which is triangular in shape. Its apex is at the spine of seventh cervical vertebra, base at external occipital crest, anterior border to cervical spines and posterior border is free.[6]

Atlanto- occipital joints are between occipital condyles and superior articular facets of atlas. They are synovial joints of ellipsoid variety. [5]Atlanto- axial joints are a pair of plane type of lateral atlanto axial joints between inferior facets of atlas and superior facets of axis

and a pivot type of median atlanto axial joint between the dens and the anterior arch and transverse ligament of atlas.[5]

FASCIA OF NECK

Superficial cervical fascia is a thin layer of subcutaneous connective tissue between the dermis of skin and investing layer of deep cervical fascia anterolaterally. It contains platysma.[5, 21]

Deep cervical fascia has three layers. Investing layer lies deep to platysma and it encloses trapezius and sternocleidomastoid muscles and parotid and submandibular salivary glands. Pretracheal fascia encloses thyroid gland and forms its false capsule. Para vertebral fascia lies in front of para vertebral muscles.[5, 21]

SUPERFICIAL MUSCLES OF NECK

Platysma, sternocleidomastoid and trapezius are the superficial muscles of neck.

Platysma is a broad thin sheet of muscle in the subcutaneous tissue of neck. Platysma helps to depress the mandible and draw the corners of mouth inferiorly.

Sternocleidomastoid is a broad strap like muscle with two heads; sternal head attaches to manubrium sterni and clavicular head attaches

to the medial third of clavicle. It is attached superiorly to the mastoid process of temporal bone. On acting bilaterally it flexes the neck and unilaterally it flexes and rotates the head and neck.

Trapezius is a large, flat, triangular muscle which covers posterolateral aspect of neck and thorax. It is attached superiorly to external occipital protuberance, superior nuchal line and ligamentum nuchae and inferiorly to lateral third of clavicle.[15, 21].

TRIANGLES OF NECK

Sternocleidomastoid muscle divides the neck into two main triangles, anterior triangle anterior to it and posterior triangle posterior to it.

Posterior triangle is bounded by sternocleidomastoid, clavicle and trapezius. It is formed by splenius capitis, levator scapulae and scalenius medius. Inferior belly of omohyoid again divides the posterior triangle into occipital triangle above, which contains occipital artery and accessory nerve and supraclavicular triangle below, which contains external jugular vein and suprascapular artery. [5, 21]

Anterior triangle is bounded by sternocleidomastoid muscle, midline of neck and mandible. It is again divided into four smaller triangles.

1. Submandibular triangle is bounded by mandible and anterior and posterior bellies of digastric muscle. It is also called digastric triangle and contains submandibular salivary gland and submandibular lymph nodes.[21]

2. Submental triangle is the unpaired suprahyoid area which is inferior to chin. It is bounded by hyoid bone and anterior bellies of both digastric muscles. Its floor is formed by myelohyoid muscles which meet in the median fibrous raphae and it contains submental lymph nodes.[21]

3. Carotid triangle is bounded by superior belly of omohyoid, posterior belly of digastric and anterior border of sternocleidomastoid muscles. It contains common carotid artery, internal jugular vein and vagus nerve in a tubular fascial condensation known as carotid sheath. The triangle is also called vascular triangle.[21]

4. Muscular triangle is bounded by superior belly of omohyoid and sternocleidomastoid muscles and median plane of neck. It contains infra hyoid muscles and viscera of neck.

MUSCLES IN THE ANTERIOR TRIANGLE

Supra hyoid and infra hyoid muscles are attached to hyoid bone.

Supra hyoid muscles attach hyoid to the skull. They are:

1. Mylohyoid muscle is attached to mandible, hyoid bone and median raphae. It forms the floor of mouth and supports the tongue and elevates it.

2. Geniohyoid muscle is attached to genial tubercle i.e. inferior mental spine of mandible and hyoid bone.

3. Stylohyoid muscle is attached to styloid process and body of hyoid bone.

4. Digastric muscle has two bellies, anterior belly arises from digastric fosse of mandible and posterior belly from mastoid notch and these two are joined by an intermediate tendon which is attached to hyoid bone by a fibrous sling.[15,21]

Infrahyoid muscles anchor hyoid bone to sternum, clavicles and scapulae and depress the hyoid bone and larynx during swallowing and speaking. They are called strap muscles because of their ribbon like appearance. Sternohyoid and omohyoid belong to superficial group and sternothyroid and thyrohyoid belong to deep group.

1. Sternohyoid muscle is narrow and lies superficially, parallel and adjacent to median line. It is attached to manubrium sterni, medial end of clavicle and body of hyoid bone.

2. Omohyoid muscle has a superior belly which is attached to inferior border of hyoid bone and an inferior belly attached to superior border of scapula. Superior belly lies laterally to sternohyoid muscle. These two bellies are united by an intermediate tendon which is connected to clavicle by a fascial sling.

3. Sternothyroid muscle is attached to posterior surface of manubrium sterni and oblique line of thyroid cartilage. It is wider than sternohyoid and lies under this and covers the lateral lobe of thyroid gland

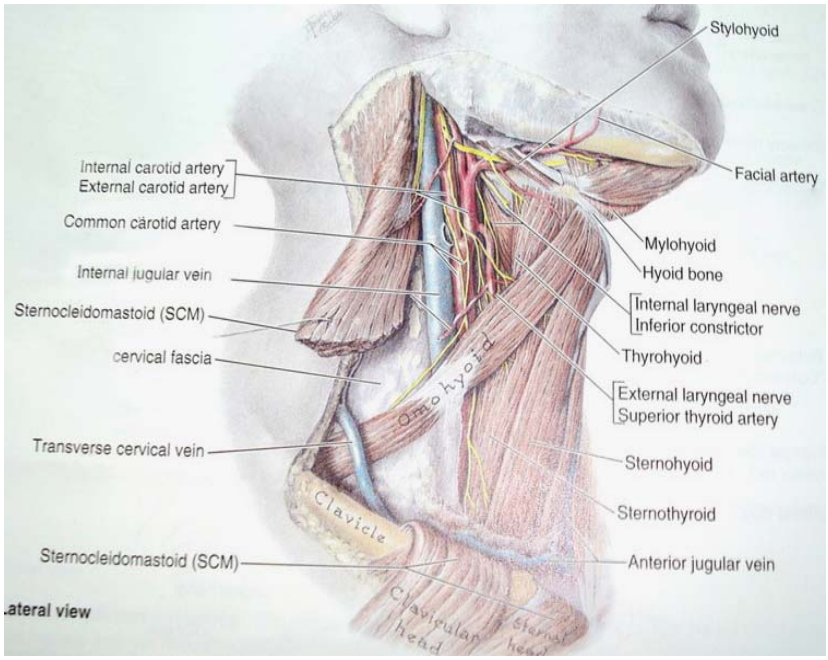


Fig.No.2 Structures of Neck[21]

4. Thyrohyoid muscle appears as a continuation of sternothyroid muscle, running superiorly from the oblique line of thyroid cartilage to inferior border and greater horn of hyoid bone. [15,21]

VESSELS OF NECK

Arteries of Neck: Common carotid artery is a branch of brachiocephalic trunk on the right side and a branch of arch of aorta on the left side. It ascends up in the carotid sheath and at the level of superior border of thyroid cartilage, opposite to the level of inter vertebral disc between third and fourth cervical vertebrae it divides into internal and external carotid arteries. Internal carotid artery is a direct continuation of common carotid artery and has no branches in the neck. External carotid artery is the main branch supplying the head and neck region. It has six branches, ascending pharyngeal, superior thyroid, lingual, facial, occipital and posterior auricular arteries and two terminal branches like maxillary and superficial temporal arteries. Carotid sinus is a small dilatation involving the common carotid artery. Carotid sinus is a baro receptor which reacts to changes in arterial blood pressure. Carotid body is a small reddish brown mass of tissue lying on the medial side of bifurcation of common carotid artery in close relation to carotid sinus. It is a chemoreceptor which monitors the levels of oxygen in the blood and

is stimulated by low levels of oxygen and initiates a reflex which increases the rate and depth of respiration, cardiac rate and blood pressure. Both carotid sinus and carotid body are innervated by Glossopharyngeal and Vagus respectively.[15, 21]

Vertebral artery arises from first part of subclavian artery and it ascends up through the foramen of transverse process of sixth cervical vertebra. The cervical part of vertebral artery then passes up in the foramen transversarium of cervical vertebrae up to the level of first cervical vertebra where it grooves the posterior arch of atlas and enters the cranial cavity through foramen magnum. The vertebral arteries on both sides join to the basilar artery and participate in the formation of cerebral arterial circle of Willis and supplies posterior part of brain.[15, 21]

VEINS OF NECK

External jugular vein is formed by the union of posterior division of retromandibular vein with posterior auricular vein at the level of mandibular angle, it crosses sternocleidomastoid muscle and perforates deep fascia to enter the subclavian vein. It is covered by platysma, superficial fascia and skin. Its tributaries are posterior jugular vein which drains upper and posterior part of neck and anterior jugular vein which drains the submandibular region. Anterior jugular veins of both sides are united by a transverse trunk called jugular arch.[5, 15]

Internal jugular vein is a direct continuation of sigmoid sinus at the level of jugular foramen and behind the sternal end of clavicle it unites with subclavian vein to form brachiocephalic vein. It drains blood from brain and deep muscles of neck.[15, 21]

NERVES OF NECK

Vagus nerve is the tenth cranial nerve and is composed of both sensory and motor fibres. It originates in the medulla oblongata and leaves through middle of jugular foramen. It passes vertically downward within the carotid sheath between common carotid artery and internal jugular vein. Branches of vagal nerve in the neck are superior laryngeal nerve, recurrent laryngeal nerve, pharyngeal branches and two to three cardiac branches which accompany the sympathetic trunk and end in cardiac plexus in thorax.[41]

Phrenic nerve is formed by anterior primary rami of third, fourth and fifth cervical spinal nerves. In addition to the sensory innervations it is the only motor supply to diaphragm.[21]

Sympathetic trunk receives white rami communicants in the neck and associates with superior, middle and inferior cervical sympathetic ganglia by way of grey rami communicants. These ganglia receive presynaptic fibres from superior thoracic spinal nerves and send post

synaptic fibres to splanchnic nerves. Superior ganglion is the largest one and gives branches to external carotid artery. Inferior ganglion gives branches to deep cardiac plexus. Middle ganglion is some times absent.[21]

DEEP STRUCTURES OF NECK

Anterior vertebral muscles

1. Longus colli muscle on the anterior surface of vertebral column extends between atlas and third thoracic vertebra.
2. Longus capitis muscle is attached to the anterior tubercles of third to sixth cervical vertebrae and basilar part of occipital bone.
3. Rectus capitis anterior muscle attached to the anterior surface of lateral mass of atlas to jugular process of occipital bone.
4. Rectus capitis lateralis muscle attached to transverse process of atlas and to jugular process of occipital bone.[16]

LATERAL MUSCLES OF NECK

1. Scalenus anterior muscle extends between anterior tubercles of transverse processes of third to sixth cervical vertebrae and scalane tubercle of first rib. It lies behind sternocleidomastoid muscle.

2. Scalenus medius muscle is the largest and longest scalene muscle. It is attached to posterior tubercle of third to seventh cervical vertebrae, transverse process of atlas and axis to upper border of first rib.

3. Scalenus posterior muscle is attached to posterior tubercle of fourth to sixth cervical vertebrae and outer surface of second rib.

4. Levator scapulae muscle is attached to transverse process of first to fourth cervical vertebrae and medial border of scapula.[15]

VISCERA OF NECK

The viscera of neck is deposited in three layers, superficial to deep are endocrine layer formed of thyroid and parathyroid glands, respiratory layer formed of larynx and trachea and alimentary layer formed of pharynx and oesophagus.[21]

ENDOCRINE LAYER

Thyroid gland: It is deep to sternohyoid and sternothyroid muscles and against fifth, sixth and seventh cervical and first thoracic vertebrae. Parathyroid glands: Superior and inferior glands on either side lie external to fibrous capsule of thyroid.[21]

RESPIRATORY LAYER

Larynx is the organ of voice production. It connects oropharynx with trachea between the levels of third to sixth cervical vertebrae. It is composed of nine cartilages, of which thyroid, cricoid and epiglottic cartilages are single, and aretynoid, corniculate and cuneiform are paired.

Thyroid cartilage (Fig.No.3) is the largest cartilage. Inferior two thirds of its plate like laminae fuses anteriorly in the median plane to form laryngeal prominence and superior part of it diverges to form superior thyroid notch. The shallow indentation in the middle of inferior border is known as inferior thyroid notch. Posterior border of each lamina projects superiorly as superior horn and inferiorly as inferior horn. Superior horns and borders are attached to hyoid bone by thyrohyoid membrane. Inferior horns articulate with lateral surface of cricoid at cricothyroid joints.

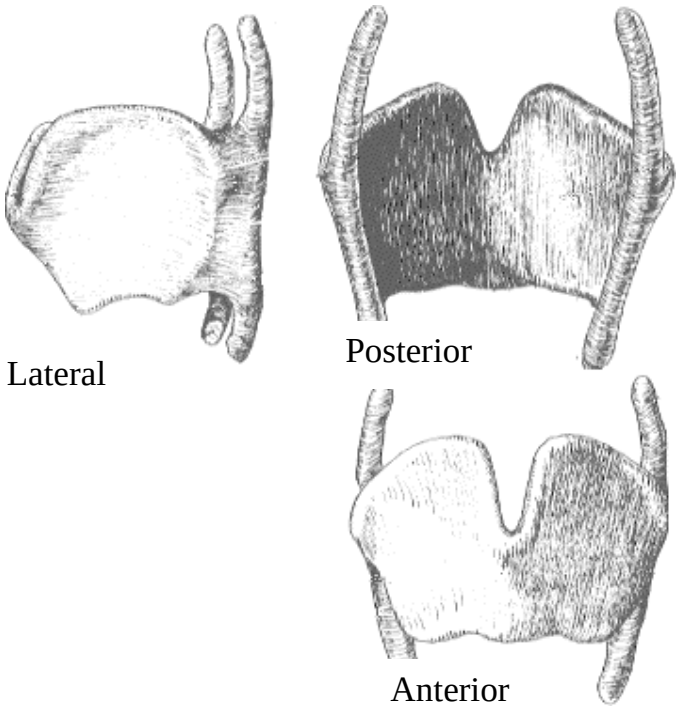


Fig.No.3 Thyroid cartilage[43]

Cricoid cartilage is a signet ring shaped thick and strong bone with its band facing anteriorly and a lamina at the posterior part.

Epiglottic cartilage is a heart shaped elastic cartilage situated posterior to root of tongue and hyoid bone and its broad superior end is free. Aretynoid cartilages are a pair of pyramid shaped cartilages articulating with lateral parts of superior border of cricoid cartilage lamina. Corniculate and cuneiform cartilages are small nodules in the posterior part of aryepiglottic folds. Triticeal cartilage is small cartilaginous nodule found in the lateral thyroid ligament.[54]

Laryngeal muscles are extrinsic muscles and intrinsic muscles. Extrinsic muscles are supra hyoid muscles which elevates larynx and

infra hyoid muscles which depresses larynx. Intrinsic muscles are cricothyroid, vocalis, thyroarytenoid, posterior cricoarytenoid, lateral thyroarytenoid and transverse and oblique arytenoid muscles. Cricothyroid muscle is the only extrinsic muscle which can be seen externally. These intrinsic muscles make alterations in the length and tension of vocal folds.[15, 21]

Trachea is a fibro-cartilaginous tube supported by incomplete tracheal rings which are deficient posteriorly where trachea is adjacent to oesophagus. It extends between the lower border of cricoid cartilage opposite sixth cervical vertebra and sternal angle opposite to inter vertebral disc between fourth and fifth thoracic vertebrae.[5, 15, 21] (Fig.No.4)

ALIMENTARY LAYER

Pharynx extends from base of the skull to the inferior border of cricoid cartilage opposite to lower border of sixth cervical vertebra. Oesophagus is a muscular tube extending down from the inferior border of cricoid cartilage opposite to lower border of sixth cervical vertebra as a continuation of laryngopharynx.[15, 21]

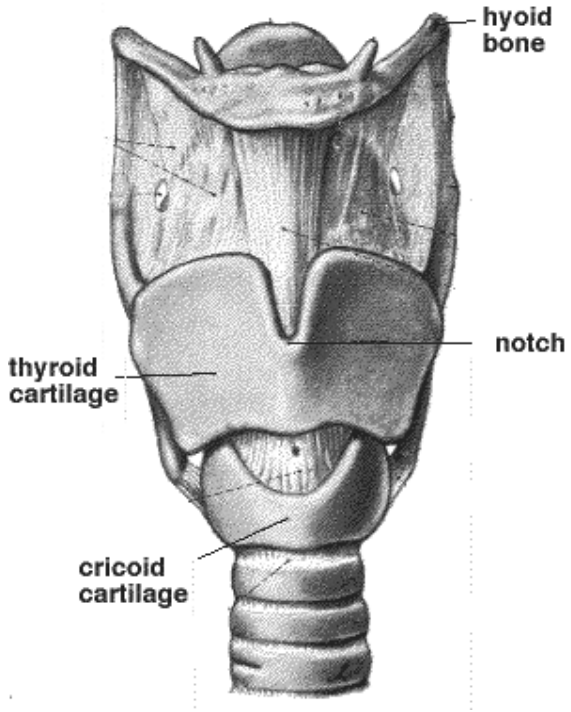


Fig No.4 Larynx [43]

CONTENTS OF VERTEBRAL CANAL

Vertebral canal contains from without inwards epidural space, duramater, subdural space, arachnoid mater, subarchnoid space with cerebrospinal fluid, spinal cord and spinal medulla.[5]

Medulla oblongata is the lowest part of brain stem, extending from lower border of pons to a plane just above the first cervical spinal nerve. Medulla contains respiratory and vasomotor centre.[5]Spinal cord is the lowest part of central nervous system, extending from lower border of atlas to lower border of first or upper border of second lumbar vertebrae.

ASPHYXIA

The term ‘asphyxia’ has originated from a Greek word ‘asphuxia’ meaning loss of heart beat.[53] ‘Asphyxia’ literally means ‘defective aeration of blood’ and etymologically, it implies ‘pulselessness’.[23] Adelson defined asphyxia or anoxia as ‘the physiologic and chemical state in a living organism in which acute lack of oxygen available for the cell metabolism is associated with inability to eliminate excess of carbon dioxide’.[23] Anoxic anoxia can occur due to interference with respiration by any mechanical obstruction in the air passages by constriction of air passages. [29] Taylor suggested the word ‘apnoea’ as more appropriate instead of asphyxia.[52] Under the broad categorization of asphyxia, death by constricting force on neck structures, include any form of pressure as in hanging and strangulation.

CHARACTERISTIC FEATURES

i. Well defined scattered tiny round pin point petechial haemorrhages noticed over the visceral surface of pleurae, under conjunctivae, over pericardium, epicardium and endocardium. They are also seen on the connective tissue of aorta and oesophagus.[42] They are the result of venous stasis leading to capillary congestion and rupture.[38] They occur due to a) increased capillary pressure, b) increased capillary permeability due to anoxia, c) increased

negative pressure in the chest due to inspiratory efforts made by subject in an attempt to overcome the obstruction of air passage. Petechial haemorrhages beneath the pleura and pericardium were first described by French Police Surgeon Auguste Ambroise Tardieu (1866) as pathognomonic of death by asphyxia and became known as Tardieu spots.[24,40,52]

ii. Cyanosis is a feature of anoxia. The word ‘cyanosis’ derived from the Greek, means ‘dark blue.’ Cyanosis indicates blue colour of skin, mucous membrane and internal organs.[23] When the airway is blocked, the oxygenation in the lungs is reduced which in turn leads to diminution in the oxygen content of the arterial blood. This will lead to darkening of all organs and tissues.[22] It become more pronounced in skin of lips, finger tips, ear lobules and also in organs.[29]

iii. Intense visceral congestion as a result of obstructed venous return.[22]

iv. Increased capillary permeability results from vasodilatation stasis and suboxia; will in turn cause transudation of fluid from capillaries into tissue spaces with oedema of organs and collection of excess fluid in pleural and pericardial sacs.[23,29]

v. Postmortem fluidity of blood may occur. Various theories have been postulated. This is due to fibrinolysins liberated from the vascular endothelium. Fibrinolysin activation occurs due to release of plasminogen activator, through the receptors on the vascular wall for vasoactive materials that increase during agonal period. Fibrinolysis is also activated by the leakage of plasminogen activator due to increased permeability, and to degeneration and necrosis of cell membrane, as a result of excessive acidosis after death.[39] Mole in 1948 demonstrated fibrinolysins in more than 90% samples of fluid and incoagulable blood.[28]

Vogel and Cordier attributed this to be due to disturbance in the plasma calcium. According to Oki the fluidity is because of the coagulum formed from conversion of fibrinogen to fibrin which is not persisting as it gets dissolved by proteolytic enzyme. Lenggenhagger opines that this dissolution of fibrin is due to acidosis.[28]

HANGING

Hanging is a form of violent asphyxial death produced by suspending the body with a ligature round the neck, the constricting force being the weight of the body or a part of body weight.[12, 27] Synonym of hanging is self suspension.[39]

When the point of suspension is over the centre of the occiput, the vessels of neck become occluded to the maximum, and this is called typical hanging. If point of suspension is any where else, it is called atypical hanging. In the study by Shrabana Kumar Naik at Pune 7.4% were typical hanging and 92.4% were atypical hanging.[31]

In hanging from high point of suspension, the victim is fully suspended with his feet clear off the ground and it is called complete hanging. Partial hanging is hanging from a low point of suspension; the bodies are either partially suspended or where the bodies are found sitting, kneeling, squatting or reclining, prone or supine position with feet, heel or knee touching the ground. Hence complete suspension is not essential to cause death by hanging, so also the constricting force need not be the weight of the whole body. Only a slight degree of constriction of neck may even cause eventual death.[49] In a study at Pune 93.5% were complete hanging and 6.5% were partial hanging.[31] In another study of 100 cases of hanging at Medical College Thiruvananthapuram 81% of cases were complete hanging and 19% were partial hanging.

Judicial Hanging is that form of hanging, when execution is carried out by hanging by neck until death, following judicial decree. The execution of the death penalty in India, under the Code of Criminal

Procedure, is carried out with hanging by neck till death for more than hundred years.

A well twisted Manilla rope of one inch in diameter having a length of 19 feet already tested with one and a half times the weight of the prisoner shall be used for executions. It should be sufficiently strong to bear a strain of 280 lbs. (127Kg) with a 7 foot drop. The knot should be placed one and half inches to the right or left of the middle line usually under the angle of jaw. The "drop" is the length of the rope from a point on the rope opposite the angle of the lower jaw of the criminal as he stands on the scaffold, to the point where the rope is embraced in the noose after allowing for the constriction of the neck that takes place in hanging. Height of drop proportioned to the weight of the prisoner. [11]

The sudden stoppage of the moving body associated with the position of the knot causes the head to be jerked violently. This cause fracture dislocation of second and third or third and fourth cervical vertebrae.[39] The body shall remain hanging for one hour and should not be taken down till the medical officer declares life to be extinct.

Sex associated asphyxia involve the males exclusively. Reduction in the blood supply to brain stimulates and heightens the sexual response. The victim may be found strangled or hanged.[51] The

suspended body of a male clothed in female attire, with complex arrangement of ligature involving the genitals and presence of padding between the ligature and neck indicate accidental hanging.[38]

Lynching is a method of homicidal hanging practiced in South America.[29] Lynch means 'to put a person to death by mob action for an alleged offence without legal trial'. [38]

MECHANISM OF DEATH BY HANGING

A number of anatomical and physiologic factors are there in the effect of constriction on neck due to hanging. The closure of airway is not an essential element of hanging. Rein both (1895) has reported a case of suicidal hanging in a man who had undergone tracheostomy and the ligature was above the level of tracheostomy.[23]

CAUSES OF DEATH CAN BE ANY OF THE FOLLOWING.

1. Occlusion of airway or Asphyxia:

It may occur either due to direct pressure over larynx or cricoid cartilage or trachea or the base of the tongue and epiglottis forced upwards and backwards against the posterior pharyngeal wall and thus obstructs airway. Asphyxiation appears to be the common cause.[27,28,29,42] Brouardel calculated that a tension of 15 Kg (33 Lbs) is

effective to close the trachea.[22,27,51] Actual compression of airway by the noose in hanging cases is not as common as generally believed.[51]

2. Occlusion of the neck veins or Venous Congestion or apoplexy or congestive suboxia:

As the ligature presses upon the neck, the jugular veins are compressed; as a result the return of blood from the brain is interfered with, when carotid blood flow remains more or less patent. This results in congestion and stasis of venous circulation of brain. Jugular veins will be closed by a tension of 2 Kg (4.4 Lbs).[38] Classical sign of congestion such as cyanosis, congestion and oedema will be markedly pronounced.

3. Occlusion of arteries or Cerebral ischaemia or Syncope or Acute Arterial Suboxia

The constricting force of the ligature may be sufficient to cause compression of the carotid arteries and thus will prevent blood flow to the brain, resulting in rapid unconsciousness from cerebral anemia. Carotid arteries are blocked by a tension of 5 Kg (11Lbs) [23, 38] or 31/2 Kg[14] and vertebral arteries by that of 30 Kg (66Lbs) [23, 38] or 16Kg[14] on the ligature.

4. Effect of pressure on nerves of neck:

The pressure of the ligature, specially when it is a thin cord which sinks deeply into tissues, may press upon the vagal sheath or carotid bodies to result in **reflex vagal inhibition**, when the collapse will be sudden, with little chance for suboxia to develop.[29, 38] Stimulation of nerve endings in the carotid sinus or sheath may be effected by direct pressure from the hands or ligature where the death may ensue immediately.[23]

5. Fracture Dislocation of cervical vertebrae

This mechanism usually occurs in the case of “Judicial hanging” or “hanging with a long drop” where death is instantaneous from the effect of fracture dislocation of second, third or fourth cervical vertebrae with compression or laceration of the spinal cord.[29]

6. Remotely Stimulated Cardiac Dysfunction (RSCD)

RSCD is a recent expression denoting impairment of cardiac function brought about by any remote neural or humeral mechanism, or by mixture of the two either due to hypoxia or due to pressure upon carotid baroreceptors.[23]

7. Combination of above factors:

When both air tubes and the blood vessels are compressed, even though the pressure on air tube is partial, death will occur from combined causes of obstructive asphyxia and impaired cerebral circulation. This is taken to be the commonest cause.[27] Death by hanging usually results from arrest of the arterial supply to the brain or obstruction of the venous return from it.[51] The cause of death in hanging, in most instances, is the compression of cervical vasculature and not asphyxia by air way obstruction.[36]

SIGNS AND SYMPTOMS

When there is obstruction or interference of the process of respiration the course of events passes through following distinct phases.[18]

A. Dyspnoeic phase with expiratory dyspnoea showing increased respiratory rate, cyanosis and tachycardia which last for 60 to 80 seconds.

B. Convulsive phase with loss of consciousness, depressed respiratory movements, facial congestion, bradycardia and convulsion which lasts for 2 minutes.

C. Pre terminal phase with respiratory pause, tachycardia and systemic hypertension which lasts for 60 to 120 seconds.

D. Gasping for breath due to primitive respiratory reflexes.

E. Finally loss of movements, absence of reflexes and dilatation of pupils which lasts for 1 to 4 minutes.

FATAL PERIOD

Fatal Period usually depend upon the mode of death. Hanging causes instantaneous death, if cervical vertebrae are fractured as in judicial hanging[27] due to pressure of the dislodged bony process on vital nerve center of the brain controlling respiration and circulation.[51] If the mode of death is pure asphyxia, death may occur very rapidly. In case of partial obstruction of air passage, death may occur with in 5-10 minutes. Death will occur least rapidly i.e. within 10-15 minutes when venous congestion is the mode of death. If vagal inhibition occurs, death will be very rapid, if not instantaneous.[39]

Death delayed for several days is rare. Delayed death occur due to aspiration pneumonia, infections, oedema of lungs, oedema of larynx, hypoxic encephalopathy, infarction of brain and abscess of brain.[39]

POST MORTEM APPEARANCES

The Post mortem findings can be divided into

A. General external appearances

B. Local external findings

C. Internal neck findings

D. Internal appearances.

A. GENERAL EXTERNAL APPEARANCE

a. Face will be pale, and not much congested in hanging.

b. Cyanosis will be noticed in hanging, when the suspension is from a low point, ligature is deeply set, or when the ligature has broken between the knot and the point of suspension.[29] Features of asphyxia are minimal in case of hanging compared to strangulation.

c. The eyes may be closed or partly open. Pupils are usually dilated or mid dilated. If the ligature knot presses upon the cervical sympathetic, the eye on the same side remain open and its pupil is dilated. It indicates ante mortem hanging.[27] Etienne Martin (1950) has described this state as “Le facies sympathique”.[38] Lopes C Portugal Medico believes this to be due to unequal tension over the structures of neck.[38] In a study of fifty cases of hanging from Medical College, Calicut two cases were with “Le facies sympathique”.[26]

d. Tongue may remain with in the teeth line or it may even be protruded and get bitten, due to base of the tongue being forced upwards by the ligature.[38] Protruding part of the tongue is commonly dark brown or even black as a result of drying.[51] Some times the tongue may be caught between teeth.[27]

e. Saliva will be found dribbling from the angle of mouth, down the chin on the chest in straight lines, opposite to the side of knot in the ligature. This is due to the increased salivation before death due to the sympathetic stimulation of salivary glands by the ligature. Salivation is increased by brain hypoxia or by stimulation of pterygopalatine ganglion.[39] The secretion of saliva is a vital act due to stimulation of salivary gland and is indicative of suspension during life, for the secretion ceases after the cessation of circulation. Evidence of dried salivary dribble marks from one of the angles of mouth is a sure sign of ante mortem hanging, but its absence alone will not suggest that the body was suspended after death.[23,27,29]

f. Blood stained frothy fluid and mucous may escape from mouth and nostrils.

g. Penis may be found engorged with blood due to hypostasis, it may be found in semi erect position with or without evidence of emission of seminal fluid in hanging.[23,42]

h. Postmortem staining will be well marked in the dependent parts of the body; in hanging if the body has been suspended for some time postmortem staining will be seen on lower part of the arms and legs of the body i.e. glove and stocking distribution.[27, 13] If the body is cut down after death, before the fixation of postmortem staining and is placed in supine position, postmortem lividity in the extremities will fade and new areas of lividity will appear along the back and buttocks.[51]

Usually fixation of postmortem staining occurs in 6 to 12 hours due to postmortem coagulation of blood in capillaries. In asphyxial deaths fixation of postmortem staining is delayed due to postmortem fluidity of blood.

B. LOCAL EXTERNAL FINDINGS

On the neck, ligature material and the ligature mark is an important finding in case of hanging or any case of constriction of neck by ligature.

LIGATURE MATERIAL

Consistency of the material

Any substance available at hand is used as ligature. Articles commonly used as ligature may be soft materials like “dhothie”, “Saree”, “Turban”, “Bed-sheet”, “Sacred thread”, “handkerchief”, ”neck tie”, “cord of pyjama”, “boot lace”, hard and pliable materials like “Electric cord”, “Belt”, “wire”, “Leather strap”, “metallic chain” and materials producing patterns like “Rope” made of cotton, coconut fibre or jute, etc or may be any thing handy and available near the place of occurrence.

Dr.Shrabana noticed soft material in 54.7% cases of hanging and hard material in 28.6% hanging cases in his study.[31] Prisoners tear their sheets into strips and use as ligature as well as they use T- shirts, under shots as ligature.[1] Rarely couples hang themselves together with the same rope.[7]

TYPE OF KNOT

Different types of knots were described.[34] The usual choice is a simple slipknot to produce a running noose or a loose loop or a fixed loop produced by non slipping granny or reef knot. Occasionally a simple loop may be used without any knot.[29] A fixed noose is one in which the rope is knotted and running noose is one in which one end of the rope is

passed through the loop made from the other end.[35] Artificer's knot is used in the case described by Tardieu.[38]

POSITION OF KNOT

The knot is usually situated over the side of the neck over the angle of mandible, mastoid region or occiput; at times it may be situated below the chin. Suspension by a knot below the chin is rare and described by Tardieu.[38] After suspension, the knot remains at a higher level than the remainder of the ligature, movement of the knot being due to the act of suspension. The position of the knot determines the force exerted on the neck by the ligature and it will be on the side opposite the point of suspension.

LIGATURE MARK

Mark of ligature on the neck is the most out standing and characteristic sign of death from hanging. The situation of the mark will be largely influenced by the method of application and movement of the ligature. The more tightly the ligature is applied, the deeper will be ligature mark.

The mark in hanging is usually situated above the level of thyroid between larynx and chin and is directed obliquely upwards towards the point of suspension and non continuous at the back or may show

irregular impression of a knot. The depth of the ligature mark will be more on the side of the neck opposite the knot.[23, 29, 38] Mark may be on or below the level of suspension in case of partial hanging.[13] The mark may be circular or oblique if a ligature is passed round the neck more than once.[27] In hanging, the ligature mark extend upwards and forms an inverted “V” in the back of neck. The inverted “V” represents where the knot of the noose was located.[9]

Considering the level of constriction represented by ligature mark, it was found to be situated on or above the level of laryngeal prominence in most cases of suicidal hanging and all cases of homicidal hangings. Ligature mark was found below the level of laryngeal prominence in 12 (4.76%) cases of suicidal hanging most of which were partial hangings.[32]

Considering discontinuity along the course of ligature mark, it was found as a common feature in most of the suicidal as well as homicidal hangings and discontinuity in the mark could not be detected in 11.11% cases of suicidal hanging and 33.33% cases of homicidal hanging.[32]

Reddy KSN has mentioned that mark of hanging is situated above the level of thyroid cartilage, between larynx and chin in 80% cases. It may be situated at the level of thyroid cartilage in about 15% cases and

below the level of thyroid cartilage in about 5% cases, especially in partial suspension.[30, 39]

Pattern of ligature material impressed on neck and characteristic diagonal marks of strands of the rope may be seen. This is known as mirror image phenomenon.[35] Ligature pattern is better appreciated by examining under oblique lighting and using magnifying lens.[39] The mark is superficial and broad if a cloth or soft material is used. The wide band of cloth when used as a ligature on the bare skin may cause narrow ligature mark due to tension lines in the stretched cloth. Ligature mark is well defined, narrow and deep if a firm string is used.

There may be two ligature marks on neck in hanging, one being oblique, non continuous and high up in the neck and the other being circular and low down in the neck due to slipping of noose from the lower to higher position for long suspension.[29]

The fibres can be lifted off by sticking thin transparent adhesive tape 5cm long around the ligature mark and its surrounding. These tapes later transferred into clean microscopic slides, can be examined directly under microscope for fibres. Inspection of the neck with oblique light may show the pattern produced by ligature. Examination under UV light will also reveal the pattern and nature of ligature.[27] Likewise

adhesive cello tapes from palms of the deceased can be examined for fibres if he / she have handled the ligature material. If fibres are detected it can be compared with those of the ligature with the help of a comparison microscope. This test is called as cellophane test or fibre test.[53]

B. INTERNAL EXAMINATION OF NECK STRUCTURES

a. Injury to subcutaneous tissue and muscles of neck

The subcutaneous tissue underneath the ligature mark on dissection will be compressed, dry, white, shiny, glistening and leathery in nature in hanging.

Injuries to neck musculature are rare in hanging.[51] Bruising and rupture of muscle fibres of platysma and sternocleidomastoid especially at their sternal attachments can be seen especially in long drops or complete hanging.[23,35] This is seen in 2-10% of cases.[12] Dr.S.Sivasuthan noted rupture of lower attachment of sternomastoid muscle in 62% of cases.[50] In a retrospective study of 175 cases of suicidal hanging over a five- year period, the most frequent injury was injury to sternocleidomastoid muscle.[3]

When a ligature around the neck suspends a body, the ligature through the muscles connecting the trunk to the head carries the weight

of the body. Among the straps muscles of neck Sternomastoid(s) are strong and bulky muscles, the lower attachments of which can easily be dissected and examined. When weight of the trunk is born by these muscles during suspension, there is every chance for rupture of the lower attachment of the muscles. In the case of hanging, death occurs in five to ten minutes except in judicial hanging where it is almost instantaneous, but the heart continues to beat for 15 to 20 minutes. Hence if the rupture of the muscles occurs, there will be definite infiltration of blood at the site. Such an infiltration will not occur if a dead body is suspended (post mortem hanging)

b. Injury to vessels of neck

Carotids may show transverse tear of the intima, with adjacent haemorrhage or with extravasations of blood in the vessel wall under the groove above the point of bifurcation in their walls as a result of friction of opposite sides due to pressure exerted by the ligature i.e. traction associated with hanging.[23,51] Direct compression of the carotid artery between the ligature and the cervical vertebra can lead to intimal tear. Even minimal trauma has been associated with carotid intimal tear or dissection and some relate such dissections to a minor traumatic event including excessive cervical rotation and hyperextension either on a repetitive basis or to an extreme degree as occurs in hanging. Tear of

intima of carotid arteries is seen in 5 to 10% of hanging cases.[38, 39] Dr. Sivasuthan has noted carotid intimal tear in 1% of cases.[40] Dr. Madan Mohan noted intimal tear in 4% of cases.[26]

c. Injury to bones of neck

Regarding the fractures, fracture of hyoid bone is an exception rather than a rule in hanging. The hyoid bone fractures were divided by Weintraub into (a) those caused by inward or side wise compression, (b) those due to anteroposterior compression, (c) traction or avulsion fractures.[23, 38] Hanging has produced both inward and outward fractures of hyoid bone.[38]

Hyoid bone is usually intact in 80% of cases of hanging.[30] In his study of one hundred hyoid bones; Renjith found hanging as major cause of hyoid bone fracture. He found an incidence of 28.5% of hyoid bone fracture, out of 21 cases of hanging, all of them were males.[40] It may get fractured involving the greater horns at the junction of outer 2/3rd and inner 1/3rd.[8]There may be traction fracture through the pressure by the ligature on the thyrohyoid ligament. Smith and Fades remarked that 'the hyoid bone is practically never injured'.[23] It is known that larynx remain cartilaginous and joints of hyoid remain mobile up to 40 years.[29] The fracture is more frequent in persons over 40 years.[8,23] In a review of 307 accidental and suicidal hangings, fractures of hyoid or thyroid

cartilages were found in 9% of cases and were more common in older individuals. In this study, genders, height of suspension and ligature type do not seem to be of predictive value. Dr.Shrabana has noted that out of his 257 cases of hanging not a single victim had hyoid bone fracture. [31]

X-ray examination is more helpful to disclose the fracture in suspected case of fracture hyoid.[3, 12]

Fracture or dislocation of upper cervical vertebrae with compression or laceration of the cord or its transection or separation from its junction with medulla, may be noticed in judicial hanging with a long drop and also in suicidal hanging where the victim jumps from a height and its fall is arrested by sudden jerk of a ligature.[27] Cervical vertebral fractures have been reported in all cases of judicial hanging in an analysis of six cases.[48]

d. Injury to cartilages of neck

Regarding the fracture of cartilages, fracture of thyroid cartilage or other cartilages are exception rather than a rule in hanging. Such fractures are more likely to occur in hanging if elderly individuals who jump to their death and remain suspended after a long drop, due to calcification of cartilage and fragility of bony structures.[51] DiMaio in his study on 83 cases of hanging noted that in more than half of the cases

there are no injuries. Only ten cases (12%) showed fractures, of which nine were thyroid cartilage fracture, specifically the superior horns; one a fracture to cervical spine and none were hyoid bone fracture. Of the nine cases of thyroid cartilage fractures, seven were unilateral and two were bilateral.[7]

Polson and Gee found fracture of superior horn/ horns of thyroid cartilage in 50% of cases of hanging.[23]Fracture of cricoid cartilage is rather less common. Fracture dislocation of cervical vertebrae is not at all common, seen only in judicial hanging.[29]

All other organs will be congested with petechiae on the surface of brain, heart and lungs.[8] Lungs were found congested and oedematous with numerous sub pleural petechial haemorrhages.[29] Typical asphyxial signs are present in 50-60% of all hanging.[8]

RESULTS

TABLE – 1

AGE WISE DISTRIBUTION OF DEATHS DUE TO HANGING

AGE(YRS)	NUMBER OF CASES	PERCENTAGE
<20	9	14%
20-30	24	38%
30-40	18	29%
40-50	6	10%
>=50	6	10%
Total	63	100%

TABLE - II
GENDER WISE DISTRIBUTION OF DEATHS DUE TO HANGING

GENDER	NUMBER OF CASES	PERCENTAGE
MALE	35	56%
FEMALE	28	44%

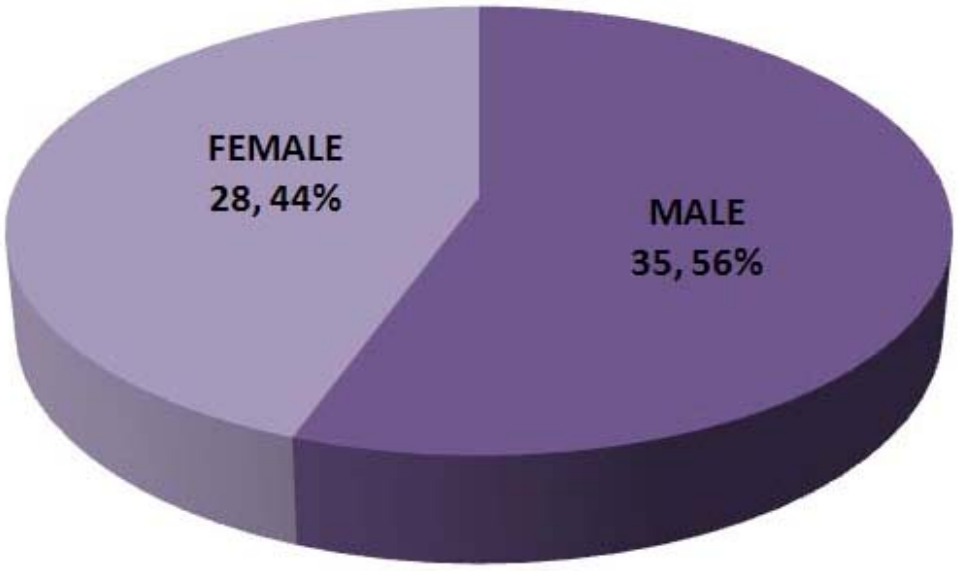


TABLE – I: Shows age wise distribution of 63 cases of deaths due to hanging. The age ranged from 13yrs to 72yrs. The age group, 20-30years, accounted for the maximum number of cases, 24cases (38%), followed by the age group 30-40yrs, 18cases (29%). Extremes of age, i.e., age less than 20yrs, comprised 9 cases (14%) and more than 60yrs, 2cases (3%) of victims each.

TABLE – II: Shows gender wise distribution of 63 cases of deaths due to hanging. The incidence among males was 56% which comprised 35 cases and among females was 44% which comprised 28 cases respectively.

TABLE - III
LIGATURE MATERIAL USED

MATERIAL USED	NUMBER OF CASES	PERCENTAGE
NYLON SAREE	19	30%
NYLON DUPATTA	14	22%
NYLON ROPE	12	19%
COIR ROPE	9	14%
COTTON LUNGI	3	5%
COTTON BEDSHEET	5	8%
COTTON SAREE	1	2%

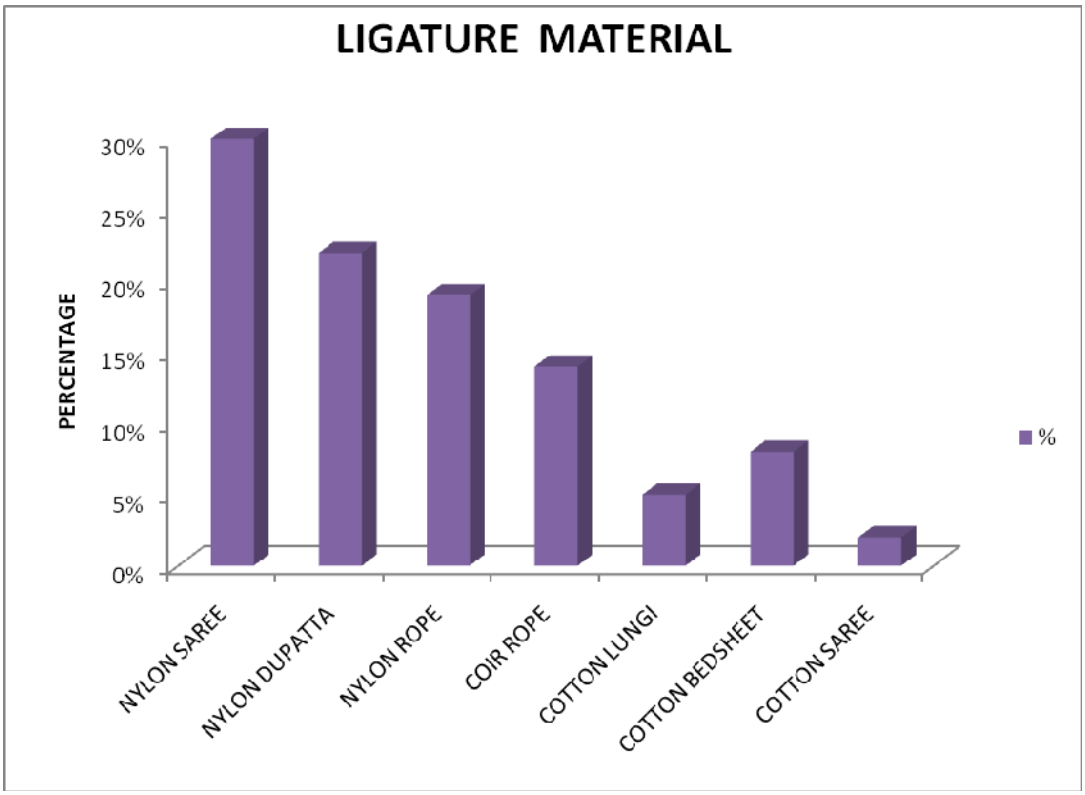


TABLE – III: Shows the incidence of ligature material used in 63 deaths due to hanging. Nylon saree is the most common ligature material that is used in 19cases (39%), next common being the nylon dupatta in 14cases (22%) and nylon rope in 12 cases (19%). Rarely used material was cotton lungi in 3cases (5%) and cotton saree in only one case (2%). So most commonly used ligature material is the commonly available household soft material, i.e., nylon saree, dupatta and rope.

TABLE - IV
TYPE OF HANGING

TYPE OF HANGING	NUMBER OF CASES	PERCENTAGE
COMPLETE	40	63%
PARTIAL	23	37%

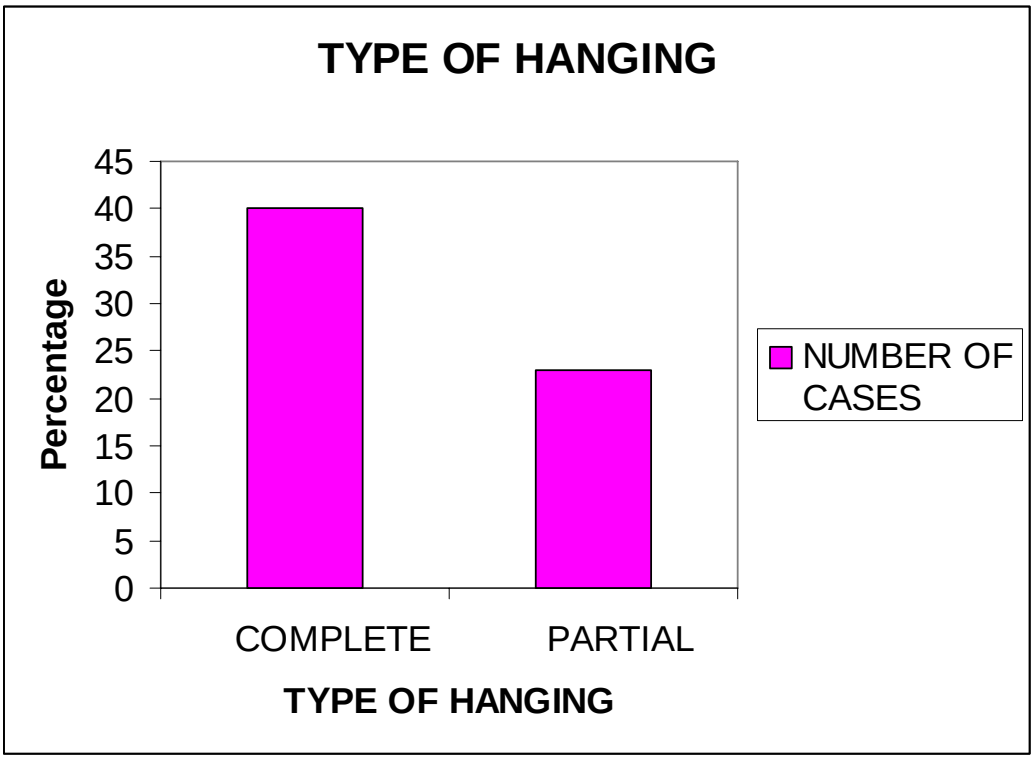


TABLE - V
POSITION OF LIGATURE MARK

POSITION OF LIGATURE MARK	NUMBER OF CASES	PERCENTAGE
ABOVE THYROID CARTILAGE	57	90%
OVER AND ABOVE THYROID CARTILAGE	6	10%

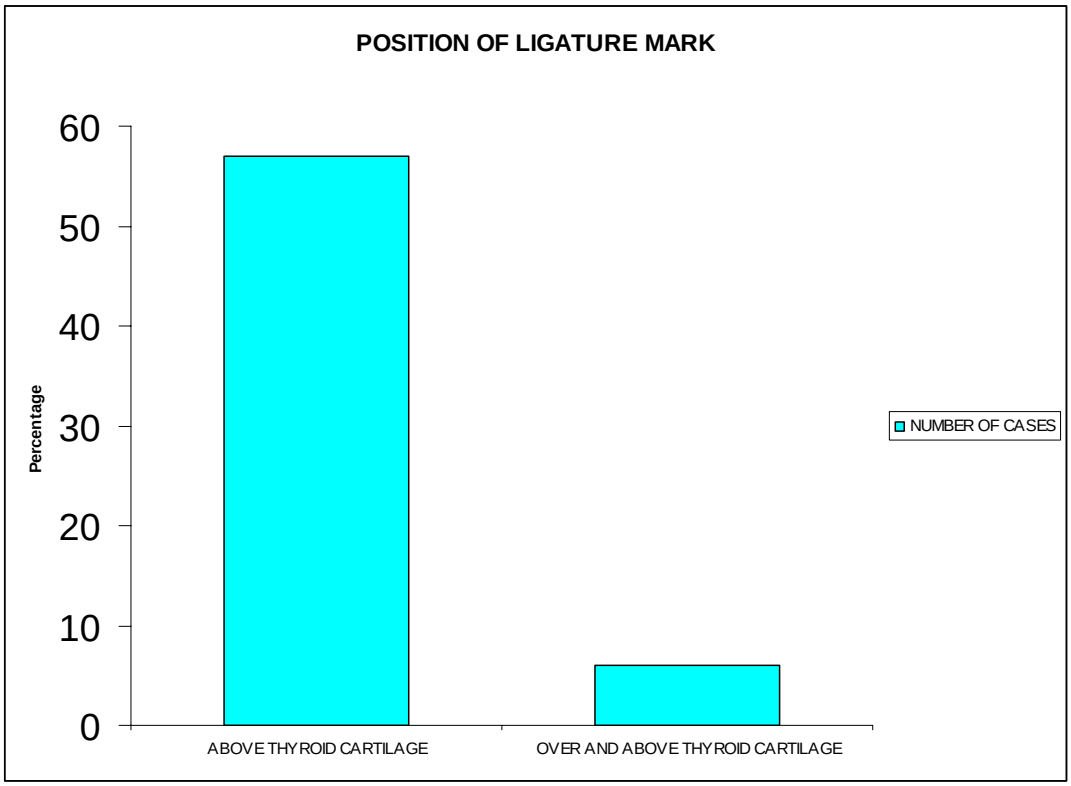


TABLE - VI

POSITION OF KNOT

POSITION OF KNOT	NUMBER OF CASES	PERCENTAGE
LEFT SIDE OF THE NECK	36	57%
BACK OF NECK	19	30%
RIGHT SIDE OF NECK	7	11%
BELOW THE CHIN	1	2%

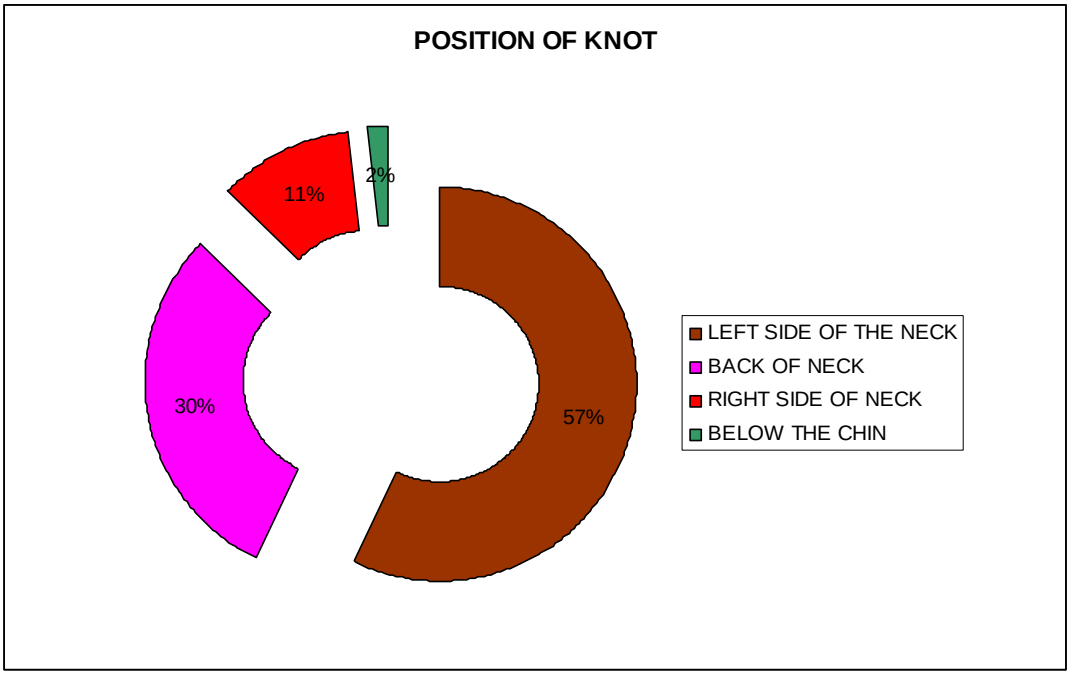


TABLE – IV: Shows incidence of complete and partial hanging in this study of 63 deaths due to hanging. Overall, 40 cases (63%) were complete hanging and 23 cases (37%) were partial hanging. So incidence of, complete hanging is twice as that of partial hanging.

TABLE – V: Shows the incidence of, ligature mark position over the neck in this study. In 57cases (90%) it was seen above the thyroid cartilage and in only 6cases (10%) it was seen over and above the thyroid cartilage.

TABLE – VI: Shows the incidence of position of the knot in this study. 19 cases (30%) were typical hanging and 44 cases (70%) were atypical. Only in one case the knot was below the chin.

TABLE - VII
INCIDENCE OF NECK STRUCTURES INJURY IN CASE OF HANGING

INJURIES	Present		Absent	
	No.	%	No.	%
RUPTURE /CONTUSION OF STERNOMASTOID AND OTHER STRAP MUSCLES OF NECK	18	29%	45	71%
CAROTID INTIMAL TEAR	19	30%	44	70%
# HYOID BONE	1	2%	62	98%
# THYROID CARTILAGE	1	2%	62	98%
# CRICOID CARTILAGE	0	0%	63	100%
# CERVICAL VERTEBRA	0	0%	63	100%

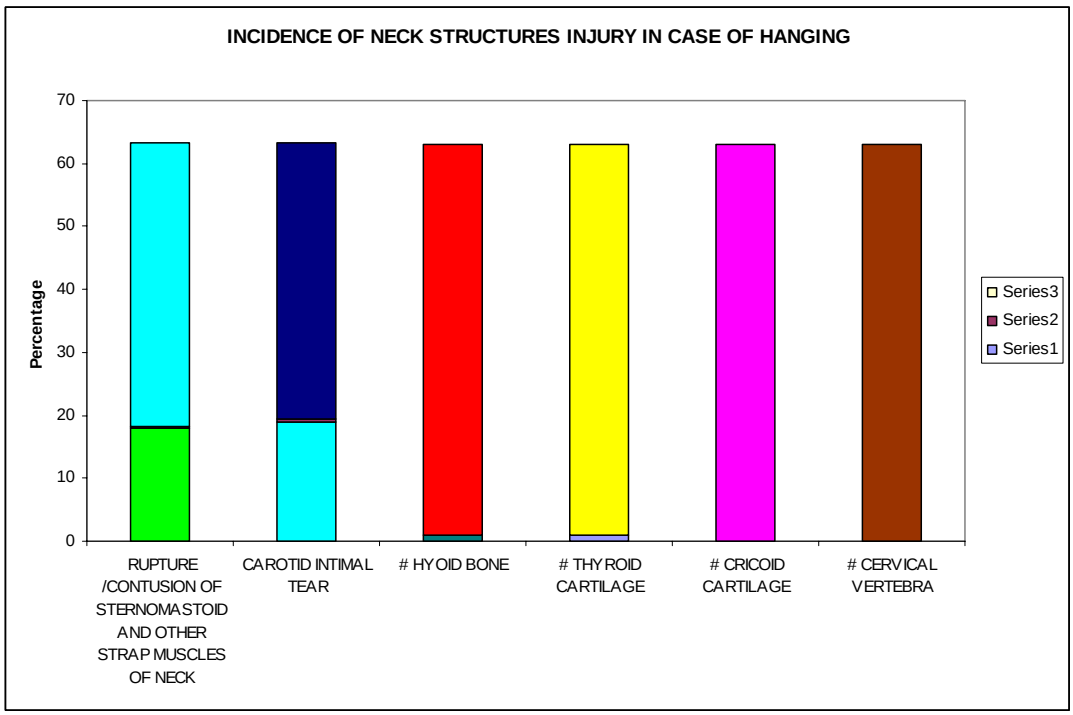


TABLE – VII : Shows incidence of internal neck structure injuries in case 63 deaths due to hanging. Out of 63 cases, carotid intimal tear and rupture/contusion to sternomastoid and other strap muscles was the commonest internal neck structure injury that was seen in 19cases (30%) and in 18cases (29%) respectively. Hyoid bone fracture and thyroid cartilage fracture was seen in only one case (2%). Fracture of cricoid cartilage and cervical vertebral fracture was not seen in any cases (0%).

TABLE - VIII
AGE WISE DISTRIBUTION OF INJURIES TO NECK STRUCTURES

1. RUPTURE/CONTUSION OF STERNOMASTOID AND OTHER STRAP MUSCLES OF NECK				
	Present		Absent	
	No.	%	No.	%
<20	3	33%	6	67%
20-30	6	25%	18	75%
30-40	4	22%	14	78%
40-50	4	67%	2	33%
>=50	1	17%	5	83%

2. CAROTID INTIMAL TEAR				
	Present		Absent	
	No.	%	No.	%
<20	1	11%	8	89%
20-30	7	29%	17	71%
30-40	5	28%	13	72%
40-50	4	67%	2	33%
>=50	2	33%	4	67%

3. FRACTURE OF HYOID BONE				
	Present		Absent	
	No.	%	No.	%
<20	0	0%	9	100%
20-30	0	0%	24	100%
30-40	0	0%	18	100%
40-50	1	17%	5	83%
>=50	0	0%	6	100%

4. FRACTURE OF THYROID CARTILAGE				
	Present		Absent	
	No.	%	No.	%
<20	0	0%	9	100%
20-30	0	0%	24	100%
30-40	0	0%	18	100%
40-50	1	17%	5	83%
>=50	0	0%	6	100%

5. FRACTURE OF CRICOID CARTILAGE				
	Present		Absent	
	No.	%	No.	%
<20	0	0%	9	100%
20-30	0	0%	24	100%
30-40	0	0%	18	100%
40-50	0	0%	6	100%
>=50	0	0%	6	100%

6. FRACTURE OF CERVICAL VERTEBRA				
	Present		Absent	
	No.	%	No.	%
<20	0	0%	9	100%
20-30	0	0%	24	100%
30-40	0	0%	18	100%
40-50	0	0%	6	100%
>=50	0	0%	6	100%

TABLE – VIII

1. RUPTURE/CONTUSION OF STERNOMASTOID AND OTHER STRAP MUSCLES OF NECK:

In this study, rupture/contusion of sternomastoid and other strap muscles of neck are more common in the age group of 40-50yrs, seen in 4cases (67%), lowest being in age group above 50yrs, seen in 1case (17%). In other age groups it is around 22-33%.

2. CAROTID INTIMAL TEAR:

Out of 63 cases, carotid intimal tear was commonly seen in the age group of 40-50yrs, i.e., around 67% of cases. The lowest being in the age group below 20yrs (11%).

3. FRACTURE OF HYOID BONE, THYROID CARTILAGE, CRICOID CARTILAGE, AND CERVICAL VERTEBRA:

In the present study, hyoid bone fracture and thyroid cartilage fracture was seen in only one case (17%) in the age group of 40-50yrs. Cricoid cartilage and cervical vertebra fracture was not seen in any cases (0%).

TABLE – IX

DISTRIBUTION OF NECK STRUCTURE INJURIES IN DIFFERENT TYPES OF HANGING

1. RUPTURE/CONTUSION OF STERNOMASTOID AND OTHER STRAP MUSCLES OF NECK				
	Present		Absent	
	No.	%	No.	%
COMPLETE	15	38%	25	63%
PARTIAL	3	13%	20	87%

2. CAROTID INTIMAL TEAR				
	Present		Absent	
	No.	%	No.	%
COMPLETE	14	35%	26	65%
PARTIAL	5	22%	18	78%

3. FRACTURE OF HYOID BONE				
	Present		Absent	
	No.	%	No.	%
COMPLETE	1	3%	39	98%
PARTIAL	0	0%	23	100%

4. FRACTURE OF THYROID CARTILAGE				
	Present		Absent	
	No.	%	No.	%
COMPLETE	1	3%	39	98%
PARTIAL	0	0%	23	100%

5. FRACTIRE OF CRICOID CARTILAGE AND CERVICAL VERTEBRA				
	Present		Absent	
	No.	%	No.	%
COMPLETE	0	0%	40	100%
PARTIAL	0	0%	23	100%

TABLE – IX

DISTRIBUTION OF NECK STRUCTURE INJURIES IN DIFFERENT TYPES OF HANGING

1. RUPTURE/CONTUSION OF STERNOMASTOID AND OTHER STRAP MUSCLES OF NECK:

This table shows incidence of rupture/contusion of sternomastoid and other neck muscles in different types of hanging. Out of 63 cases of death due to hanging injury to sternomastoid and other neck muscles was found to be more common in complete hanging, 15cases (38%). In partial hanging it was seen only in 3cases (13%).

2. CAROTID INTIMAL TEAR:

Carotid intimal tear was more common in complete hanging, 14cases (35%). In partial hanging it was seen in only 5 cases (22%).

3. FRACTIRE OF HYOID BONE, THYROID CARTILAGE, CRICOID CARTILAGE AND CERVICAL VERTEBRA:

Fracture of hyoid bone and thyroid cartilage was seen in only complete hanging, 1case (3%). Fracture of cricoid cartilage and cervical vertebra was not seen both in complete or partial hanging cases.

TABLE – X

RELATIONSHIP OF POSITION OF KNOT WITH INJURIES

1.STERNOMASTOID RUPTURE				
	Present		Absent	
	No.	%	No.	%
BACK OF NECK	7	37%	12	63%
BELOW THE CHIN	0	0%	1	100%
LEFT SIDE OF THE NECK	10	28%	26	72%
RIGHT SIDE OF NECK	1	14%	6	86%

2. CAROTID INTIMAL TEAR				
	Present		Absent	
	No.	%	No.	%
BACK OF NECK	8	42%	11	58%
BELOW THE CHIN	1	100%	0	0%
LEFT SIDE OF THE NECK	9	25%	27	75%
RIGHT SIDE OF NECK	1	14%	6	86%

3. FRACTURE OF HYOID BONE				
	Present		Absent	
	No.	%	No.	%
BACK OF NECK	1	5%	18	95%
BELOW THE CHIN	0	0%	1	100%
LEFT SIDE OF THE NECK	0	0%	36	100%
RIGHT SIDE OF NECK	0	0%	7	100%

4. FRACTURE OF THYROID CARTILAGE				
	Present		Absent	
	No.	%	No.	%
BACK OF NECK	1	5%	19	100%
BELOW THE CHIN	0	0%	1	100%
LEFT SIDE OF THE NECK	0	0%	36	100%
RIGHT SIDE OF NECK	0	0%	7	100%

5. FRACTURE OF CRICOID CARTILAGE AND CERVICAL VERTEBRA				
	Present		Absent	
	No.	%	No.	%
BACK OF NECK	0	0%	19	100%
BELOW THE CHIN	0	0%	1	100%
LEFT SIDE OF THE NECK	0	0%	36	100%
RIGHT SIDE OF NECK	0	0%	7	100%

TABLE – X

RELATIONSHIP OF POSITION OF KNOT WITH INJURIES

1. STERNOMASTOID RUPTURE:

The incidence of injury to sternomastoid or other neck muscles were more common when the position of the knot was on the left side of the neck, seen in 10cases (28%) and to the back of the neck, seen in 7 cases (37%), respectively. It was not seen when the knot was below the chin.

2. CAROTID INTIMAL TEAR:

Carotid intimal tear was seen in all positions of the knot. But it is more common when it was on the left side of the neck and to the back.

3. FRACTURE OF HYOID BONE, THYROID CARTILAGE, CRICOID CARTILAGE AND CERVICAL VERTEBRA:

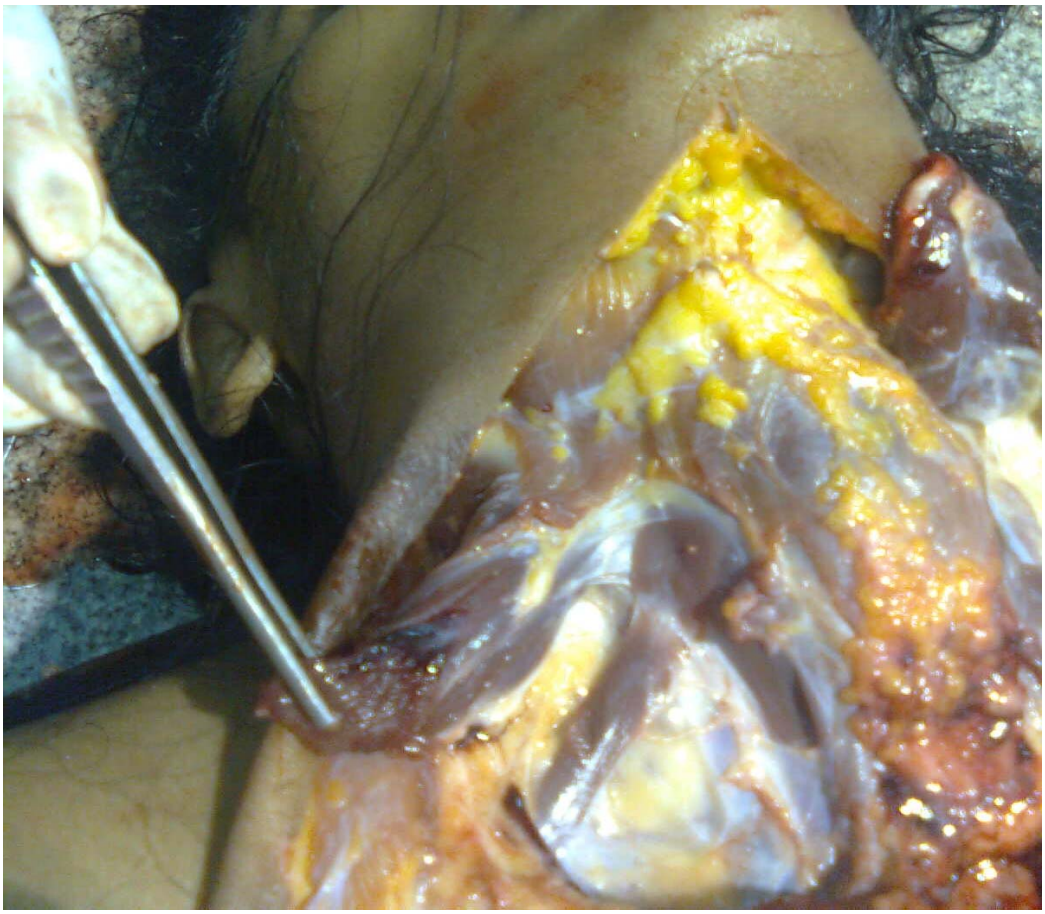
Fracture of hyoid bone and thyroid cartilage was seen when the knot position was to the back of the neck, 1 case (5%). Fracture of cricoid cartilage and cervical vertebra was not seen in any knot position.

LAYER BY LAYER DISSECTION OF NECK

CAROTID INTIMAL TEAR

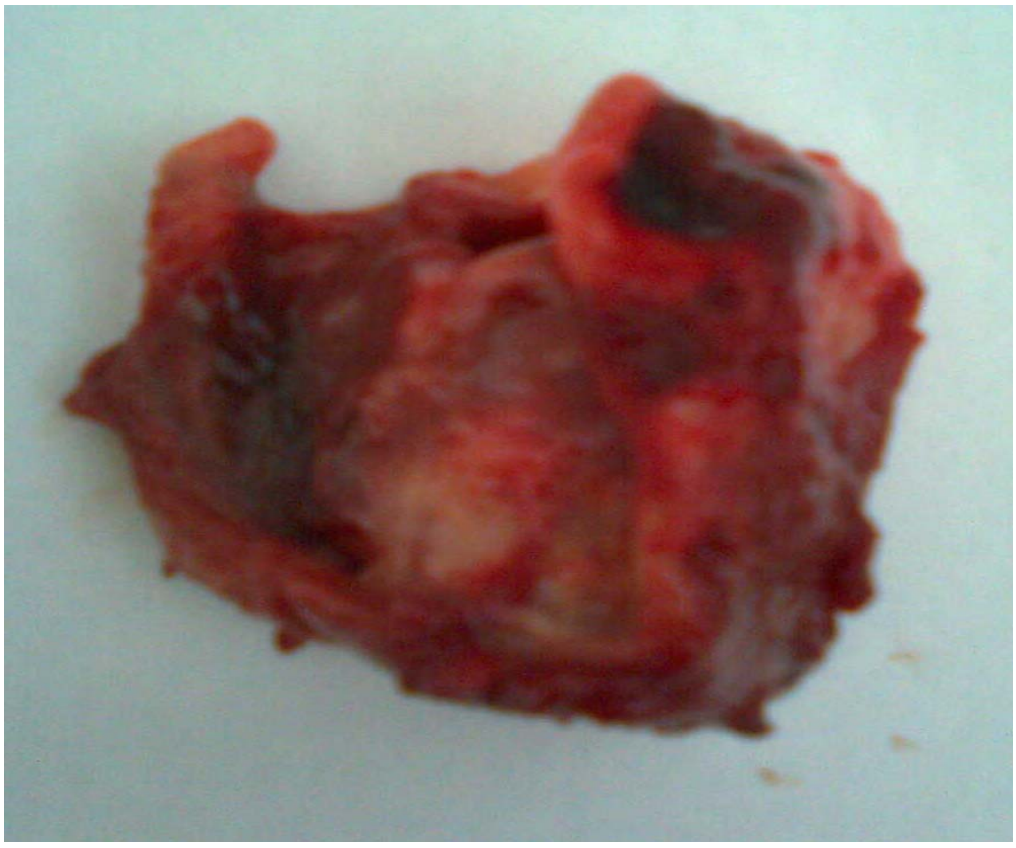
STERNOMASTOID CONTUSION ON LEFT SIDE

STERNOMASTOID CONTUSION ON RIGHT SIDE



FRACTURE OF HYOID BONE

FRACTURE OF THYOID CARTILAGE



DISCUSSION

DISCUSSION

Hanging remains to be one of the common methods of committing suicide. It is particularly a lethal method of suicide with an estimated fatality rate of over 70%. In contrast to overdose there is little opportunity to change one's mind as death generally occurs rapidly after suspension. The last 30yrs have seen an increase in hanging suicides, particularly amongst young males all over the world.

In the present study, which was conducted at the Institute of Forensic Medicine, Madras Medical college and Government General Hospital, Chennai-3, from August 2008 to July 2009, deaths due to hanging was seen in 63 cases.

SEX INCIDENCE

In this study of 63 deaths due to hanging, 34 cases (56%) were male and 28 cases (44%) were females. So incidence of hanging is more in males when compared to females. In a retrospective study, done ***by Dr.B.R. Sharma et al (2005),*** the male:female ratio was 2:1.[44]

AGE INCIDENCE

In this study, deaths due to hanging was seen from 13yrs to 72yrs of age. Maximum incidence being in the age group of 20 -30years, 24cases (38%), followed by the age group 30-40yrs, 18 cases (29%). Extremes of age, less than 20yrs, comprised 9 cases (14%) and more than 60yrs, 2cases (3%) of victims each, where as in a study done ***by B.R.Sharma et al (2005)***, young adults of the age group of 21-30yrs accounted for 46%, which is almost similar to the present study.[44]

LIGATURE MATERIAL

Any substance available at hand is used as ligature material. The most commonly used ligature material in both sexes in this study is nylon saree 19cases (30%), next being nylon dupatta 14 cases (22%) and nylon rope 12 cases (19%). The most common ligature points that were used were beams, hooks and ceiling fans. ***Dr.Shrabana*** noticed soft material in 54.7% cases of hanging and hard material in 28.6% hanging cases in his study.[32 47]

LIGATURE MARK

Ligature mark was seen in all the 63cases of deaths due to hanging. It crossed the midline of the front of the neck above the thyroid cartilage in 57cases (90%) and over and above the thyroid cartilage in 6cases (10%), where as in a retrospective study done ***by Dr. B.R.Sharma et al (2005)***, wherein the ligature mark was placed above thyroid cartilage in 85% of cases.[44] Reddy KSN has mentioned that mark of hanging is situated above the level of thyroid cartilage, between larynx and chin in 80% cases. It may be situated at the level of thyroid cartilage in about 15% cases and below the level of thyroid cartilage in about 5% cases, especially in partial suspension.[30, 41]

POSITION OF THE KNOT

The knot is usually situated over the side of the neck, over the angle of mandible, mastoid region or occiput; at times it may be situated below the chin. Suspension by a knot below the chin is rare as described by Tardieu.[40]

In the present study, the knot was located on left side of the neck in 36cases (57%), to the back of the neck in 19cases (30%), and to the right side of the neck in 7cases (11%). In only one case the knot was placed below the chin (2%). Whereas in a retrospective study, done by ***Dr.B.R.Sharma et al (2005)***, position of the knot was commonly seen on

the left side of the neck in 43% of cases, to the right side of the neck in 31% of cases and to the back in 24% of cases.[44] ***Dr. Madan Mohan*** noted that in 46% of cases the knot is on the side and in 4% cases on the back.[26]

TYPES OF HANGING

In this study, complete hanging was seen in 40cases (63%) and partial hanging in 23cases (37%). Whereas in a restrospective study done by ***Dr.B.R. Sharma et al (2005),*** complete hanging was seen in 45cases (68%) and partial haning in 21 cases (32%).[44] The incidence was similar to the present study.

INCIDENCE OF INJURY TO NECK STRUCTURES IN CASE OF HANGING

Out of 63 cases, carotid intimal tear was seen in 19cases (30%), and rupture/contusion to sternomastoid and other strap muscles seen in 18cases (29%). These two criteria were the commonest internal neck structure injury observed in this present study. Hyoid bone fracture and thyroid cartilage fracture were seen in only one case (2%). Fracture of cricoid cartilage and fracture and dislocation of cervical vertebral was not seen in any cases (0%). Carotid intimal tear was seen in 5 to 10% of hanging cases as per various studies.[39] ***Dr. Sivasuthan*** has noted

carotid intimal tear in 1% of cases and sternomastoid injury in 62% of cases.[50] ***Dr. Madan Mohan*** noted intimal tear in 4% of cases.[26]

Where as in a restrospective study done ***by Dr.B.R. Sharma et al (2005),*** injury to blood vessels was seen in only 6cases (9%) , injury to sternomastoid and other neck muscles were seen in 28 cases (42%), hyoid bone fracture in 10cases (15%), and thyroid cartilage fracture in 8cases (12%).[44]

In the present study the incidence of carotid intimal tear is on the higher side when compared to other studies.

AGE WISE INJURY TO NECK STRUCTURES IN HANGING

Rupture/contusion of sternomastoid and other strap muscles of neck are more common in the age group of 40-50yrs, seen in 4cases (67%), lowest being in age group above 50yrs, seen in 1case (17%) and between the age group of 30-40yrs, (22%). Whereas in a prospective study done ***by Dr. Shivasudhan*** it was commonly seen in the age group of 22-31yrs, in 16 cases (70%) and 42-51yrs in 13 cases (72%) respectively. Incidence was less after 60yrs of age and between age group of 32-41yrs (37%).[50]

Carotid intimal tear was commonly seen in the age group of 40-50yrs, i.e., around 67% of cases. The lowest being in age group of below 20yrs (11%).

Hyoid bone fracture and thyroid cartilage fracture was seen in one case (17%) in the age group of 40-50yrs. Cricoid cartilage and fracture and dislocation of cervical vertebra was not seen in any cases (0%). Where as in a study done by ***Dr.B.R. Sharma et al (2005)*** hyoid fracture was seen in 15% of cases and thyroid cartilage fracture in 9% of cases and 52% of injury rate, in those over the age of 40yrs, probably because of increasing brittleness of the laryngeal structures with increasing age.[44]

DISTRIBUTION OF NECK STRUCTURE INJURIES IN DIFFERENT TYPES OF HANGING

Out of 63 cases of death due to hanging, injury to sternomastoid and other strap muscles of neck was found to be more common in complete hanging, 15cases (38%), in partial hanging, it was seen only in 3cases (13%). Where as in a restrospective study done by ***Dr.B.R. Sharma et al (2005),*** injury to sternomastoid and other muscles was found to be more common in complete hanging, 16cases (40%) and in partial hanging, 8cases (44%).[44] So injury to strap muscles of neck is more likely to be seen in complete hanging than in partial hanging.

In the present study, carotid intimal tear was more common in complete hanging, 14cases (35%). In partial hanging, it was seen in only 5 cases (22%). Where as in a restrospective study of 66cases done by ***Dr.B.R. Sharma et al (2005),*** injury to blood vessels were more common in complete hanging, 6cases and in partial hanging it was seen in only 2cases.[44] So, carotid intimal tear is more common in complete hanging in both the studies.

Fracture of hyoid bone and thyroid cartilage was seen in only complete hanging, 1case (3%). Fracture of cricoid cartilage and cervical vertebra was not seen in cases of both complete or partial hanging. Whereas in a restrospective and prospective study of 108cases done by ***Dr Sharma BR, Singh VP and Harish D (2005),*** injury to hyoid bone and thyroid cartilage was seen in 46% of complete hanging and 54% of partial hanging cases.[45]

CONCLUSION

CONCLUSION

A prospective study of deaths due to hanging was done during the period of August 2008 to July 2009, from the medicolegal autopsies conducted at the Institute of Forensic Medicine, Madras Medical College Hospital, Chennai-3. During that period, there were 63 deaths due to hanging. From this study, the following conclusions could be drawn:

1. Most of the deaths due to hanging were in the age group of 20-30yrs (38%).
2. Incidence of hanging was slightly more in males (56%) when compare to females.
3. Place of hanging being in their own residence in all the cases except 2cases.
4. Most common reason for hanging is marital disharmony.
5. Most common ligature material is the Nylon saree and Nylon duppatta, i.e. easily available soft material at home.
6. Most common type of hanging is complete hanging (63%) and commonest position of knot is to the left side of neck (57%).
7. In the present study the commonest internal neck structure injury is the carotid intimal tear (30%), next common being rupture/contusion to the sternomastoid and other strap muscles of neck (29%).

8. The injury to sternomastoid and other strap muscles of neck are more common in the age group of 40-50yrs.
9. Incidence of carotid intimal tear was more in the age group of 40-50yrs.
10. Injury to hyoid bone and thyroid cartilage were very rare (3%) and it was seen in patients above 40yrs of age.
11. Fracture to cricoid cartilage and cervical vertebra were not seen in any cases (0%).
12. All the neck structure injuries are common in complete hanging.

RECOMMENDATION

RECOMMENDATION

A careful forensic examination of cases of hanging, even if it is suicidal, is of great importance with the aim of ascertaining the ante-mortem characteristic of the lesion to exclude the possibility of murder dissimulation.

As the ligature mark being mainly a postmortem phenomenon, any inner neck structure injury indicating ligature mark intravitality has to be identified to establish the antemortem hanging.

There are occasions, when the injury to the neck structures caused by hanging becomes difficult to appreciate for the doctor conducting autopsy and as such, there is need for studies at different setups to examine the profile of neck structure injuries, so as to differentiate the suicidal or homicidal nature of such deaths with certainty.

Studies of this type require not only prospective collection of data but also pre-study standardization of dissection technique, particularly where there is involvement of different prosecutors.

The reason for the relatively high prevelance of carotid intimal tear as seen in my study and its exact mechanism in case of hanging has to be further studied.

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APPENDICES

PROFORMA

Name:

Age:

Sex:

Address:

Education/ Occupation:

PM No : CRIME No:

Police Station:

Date of admission: Date of death:

HISTORY:

a. Place of hanging:

b. Type of hanging: Complete/ partial

c. Ligature material:

d. Position of knot:

e. SOC report:

f. If suicide, reason for commiting suicide:

g. Previous H/O attempted suicide:

h. Any Suicidal note:

j. Any previous illness/ drug intake/ alcoholic:

AUTOPSY FINDINGS:

EXTERNAL EXAMINATION:

a. Signs of asphyxia: Bluish discoloration of nails/ sphincter relaxation/ congestion of face/petechial haemorrhages

b. Dribbling of saliva:

c. Le-facie sympathetic:

d. Pattern of hypostasis:

e. Rigor mortis:

f. Ligature mark:

g. Other injuries:

INTERNAL EXAMINATION: 1**. On dissection of neck:**

a. Injury to sternomastoid muscle and other strap muscles of neck

b. carotid intimal tear

c. Fracture of Hyoid bone

d. Fracture of Thyroid cartilage

e. Fracture of Cricoid cartilage

f. Fracture and/dislocation of cervical vertebra

2. Examination of other internal organs:

LAB INVESTIGATION:

MASTER CHART

SL NO	AGE	SEX	HISTORY	PLACE OF HANGING	MATERIAL USED	COMPLETE/PARTIAL	POSITION OF KNOT	NO. OF DAYS ALIVE OR BROUGHT DEAD	POSITION OF LIGATURE MARK	INJURY TO STERNOMASTOID AND OTHER STARP MUSCLES	CAROTID INTIMAL TEAR	# OF HYOID BONE	# OF THYROID CARTILAGE	# OF CRICOID CARTILAGE	FRACTURE DISLOCATION OF CERVICAL VERTEBRA
1	18YRS	F	FAILURE IN 10TH EXAM	RESIDENCE	COIR ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON RIGHT SIDE	ABSENT	-	-	-	-
2	30YRS	M	POLIOMYELITIS LEFT LOWERLIMB, UNABLE TO GET MARRIED	RESIDENCE	COTTON LUNGI	PARTIAL	BACK	BROUGHT DEAD	OVER AND ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
3	24YRS	F	MARRIED LIFE 3YRS, ISSUELESS	RESIDENCE	NYLON SAREE	COMPLETE	RIGHT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON LEFT SIDE	PRESENT ON BOTH	-	-	-	-
4	56YRS	M	PSYCHIATRIC PATIENT ON TREATMENT	RESIDENCE	BEDSHEET	PARTIAL	LEFT SIDE	BROUGHT DEAD	OVER AND ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
5	35YRS	M	DIVORCEE, ALCOHOLIC, DEPRESSED	RESIDENCE	NYLON DUPATTA	COMPLETE	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	PRESENT ON BOTH SIDES	-	-	-	-
6	13YRS	F	FAILED IN 8TH EXAM	RESIDENCE	NYLON DUPATTA	PARTIAL	BACK	ADMITTED FOR 2 DAYS	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
7	17YRS	F	FAILURE IN +2 EXAM	RESIDENCE	NYLON DUPATTA	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON RIGHT SIDE	ABSENT	-	-	-	-
8	35YRS	M	BUSINESS FAILURE	RESIDENCE	COIR ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
9	23YRS	F	DOWRY HARRASMENT	RESIDENCE	NYLON SAREE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON RIGHT SIDE	ABSENT	-	-	-	-
10	35YRS	M	MARITAL DISHARMONY	RESIDENCE	NYLON ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
11	20YRS	F	DOWRY HARRASMENT	RESIDENCE	NYLON DUPATTA	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON RIGHT SIDE	ABSENT	-	-	-	-
12	34YRS	M	ALCOHOLIC, QUARREL WITH WIFE	RESIDENCE	NYLON SAREE	PARTIAL	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
13	65YRS	M	UNCONTROLLABLE PAIN ABDOMEN	RESIDENCE	NYLON ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON RIGHT SIDE	PRESENT ON BOTH SIDES	-	-	-	-
14	72YRS	M	DEPRESSED, ALCOHOLIC	OFFICE REST ROOM	BEDSHEET	PARTIAL	LEFT SIDE	BROUGHT DEAD	OVER AND ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
15	26YRS	F	UNCONTROLLABLE PAIN ABDOMEN	RESIDENCE	NYLON DUPATTA	COMPLETE	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
16	49YRS	M	BUSINESS FAILURE	RESIDENCE	NYLON ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	PRESENT ON RIGHT SIDE	-	-	-	-
17	20YRS	M	CHRONIC PAIN ABDOMEN	RESIDENCE	NYLON DUPATTA	PARTIAL	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
18	28YRS	F	ISSUELESS	RESIDENCE	NYLON SAREE	PARTIAL	RIGHT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
19	30YRS	M	FINANCIAL PROBLEM	LODGE	NLON ROPE	PARTIAL	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	PRESENT ON RIGHT	-	-	-	-
20	20YRS	F	DOWRY HARRASMENT	RESIDENCE	COTTON BEDSHEET	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON BOTH SIDES	PRESENT ON RIGHT SIDE	-	-	-	-
21	49YRS	M	DIVORCEE, ALCOHOLIC	PARK	NYLON ROPE	PARTIAL	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	RIGHT SIDE OF NECK	PRESENT ON BOTH SIDES	-	-	-	-
22	32YRS	M	MARITAL DISHARMONY	RESIDENCE	COTTON BEDSHEET	COMPLETE	RIGHT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
23	40yrs	F	CHRONIC PAIN ABDOMEN	RESIDENCE	NYLON SAREE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-

MASTER CHART

SL NO	AGE	SEX	HISTORY	PLACE OF HANGING	MATERIAL USED	COMPLETE/PARTIAL	POSITION OF KNOT	NO. OF DAYS ALIVE OR BROUGHT DEAD	POSITION OF LIGATURE MARK	INJURY TO STERNOMASTOID AND OTHER STARP MUSCLES	CAROTID INTIMAL TEAR	# OF HYOID BONE	# OF THYROID CARTILAGE	# OF CRICOID CARTILAGE	FRACTURE DISLOCATION OF CERVICAL VERTEBRA
24	35YRS	M	MARITAL DISHARMONY	RESIDENCE	NYLON ROPE	COMPLETE	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON RIGHT SIDE	ABSENT	-	-	-	-
25	56YRS	M	CHRONIC ILLNESS	RESIDENCE	COIR ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
26	30YRS	M	UNEMPLOYED, DEPRESSED	RESIDENCE	NYLON SAREE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
27	24YRS	F	CHRONIC PAIN ABDOMEN	RESIDENCE	NYLON DUPATTA	PARTIAL	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	PRESENT ON RIGHT SIDE	-	-	-	-
28	21YRS	F	DOWRY HARRASMENT	RESIDENCE	NYLON SAREE	COMPLETE	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
29	36YRS	M	FINANCIAL PROBLEM	RESIDENCE	COIR ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
30	28YRS	M	MARITAL DISHARMONY	RESIDENCE	NYLON SAREE	PARTIAL	RIGHT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
31	22YRS	F	MARITAL DISHARMONY	RESIDENCE	NYLON SAREE	COMPLETE	LEFT SIDE	ALIVE FOR 12HRS	ABOVE THYROID CARTILAGE	ABSENT	PRESENT ON RIGHT	-	-	-	-
32	27YRS	M	MARITAL DISHARMONY	RESIDENCE	NYLON ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON RIGHT SIDE	PRESENT ON BOTH SIDES	-	-	-	-
33	18YRS	F	CHRONIC PAIN ABDOMEN	RESIDENCE	NYLON DUPATTA	COMPLETE	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
34	22YRS	F	UNCONTROLLABLE PAIN ABDOMEN	RESIDENCE	NYLON DUPATTA	COMPLETE	BELOW CHIN	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	PRESENT ON BOTH SIDES	-	-	-	-
35	48YRS	M	MARITAL DISHARMONY	RESIDENCE	NYLON ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON RIGHT SIDE	ABSENT	-	-	-	-
36	21YRS	M	PSYCHIATRIC PATIENT ON TREATMENT	RESIDENCE	BEDSHEET	PARTIAL	LEFT SIDE	BROUGHT DEAD	OVER AND ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
37	29YRS	F	DEPRESSED, H/O PREVIOUS SUICIDAL ATTEMPT PRESENT	RESIDENCE	NYLON DUPATTA	COMPLETE	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
38	19YRS	M	LOVE FAILURE	RESIDENCE	COIR ROPE	PARTIAL	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
39	24YRS	F	DOWRY HARRASMENT	RESIDENCE	NYLON SAREE	PARTIAL	RIGHT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
40	25YRS	F	DOWRY HARRASMENT	RESIDENCE	NYLON SAREE	COMPLETE	LEFT SIDE	ALIVE FOR 2HRS	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
41	32YRS	M	MARITAL DISHARMONY	RESIDENCE	NYLON ROPE	COMPLETE	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON BOTH SIDES	PRESENT ON RIGHT SIDE	-	-	-	-
42	28YRS	M	ALCOHOLIC, FAMILY PROBLEM	RESIDENCE	COIR ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON RIGHT SIDE	ABSENT	-	-	-	-
43	25YRS	F	DOWRY HARRASMENT	RESIDENCE	NYLON SAREE	PARTIAL	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-

MASTER CHART

SL NO	AGE	SEX	HISTORY	PLACE OF HANGING	MATERIAL USED	COMPLETE/PARTIAL	POSITION OF KNOT	NO. OF DAYS ALIVE OR BROUGHT DEAD	POSITION OF LIGATURE MARK	INJURY TO STERNOMASTOID AND OTHER STARP MUSCLES	CAROTID INTIMAL TEAR	# OF HYOID BONE	# OF THYROID CARTILAGE	# OF CRICOID CARTILAGE	FRACTURE DISLOCATION OF CERVICAL VERTEBRA
44	22YRS	F	UNCONTROLLABLE PAIN ABDOMEN	RESIDENCE	NYLON DUPATTA	PARTIAL	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	PRESENT ON LEFT SIDE	-	-	-	-
45	42YRS	M	UNMARRIED, EPILEPTIC, DEPRESSED	RESIDENCE	COIR ROPE	PARTIAL	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON RIGHT SIDE	PRESENT ON BOTH SIDES	-	-	-	-
46	28YRS	M	MARITAL DISHARMONY	RESIDENCE	COTTON LUNGI	PARTIAL	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
47	40YRS	M	MARITAL DISHARMONY	RESIDENCE	COTTON SAREE	COMPLETE	BACK	BROUGHT DEAD	OVER AND ABOVE THYROID CARTILAGE	PRESENT ON BOTH SIDES	PRESENT ON LEFT SIDE	+	+	-	-
48	17YRS	F	FAILED IN +2 EXAMS	RESIDENCE	NYLON DUPATTA	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
49	16YRS	F	MOTHER SCOLDED FOR NOT STUDYING	RESIDENCE	NYLON DUPATTA	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
50	25YRS	F	DOWRY HARRASMENT	RESIDENCE	NYLON SAREE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
51	38YRS	M	MARITAL DISHARMONY	RESIDENCE	COIR ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
52	35YRS	M	MARITAL DISHARMONY	RESIDENCE	NYLON ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
53	35YRS	F	DOWRY HARRASMENT	RESIDENCE	NYLON SAREE	COMPLETE	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON RIGHT SIDE	PRESENT ON BOTH SIDES	-	-	-	-
54	28YRS	M	DEPRESSED, UNABLE TO GET A GOOD JOB	RESIDENCE	NYLON SAREE	PARTIAL	RIGHT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
55	32YRS	M	FINANCIAL PROBLEM	RESIDENCE	NYLON SAREE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
56	35YRS	M	MARITAL DISHARMONY	RESIDENCE	NYLON ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON RIGHT SIDE	PRESENT ON RIGHT SIDE	-	-	-	-
57	23YRS	F	DOWRY HARRASMENT	RESIDENCE	NYLON SAREE	PARTIAL	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
58	50YRS	F	CHRONIC PAIN ABDOMEN	RESIDENCE	NYLON DUPATTA	PARTIAL	RIGHT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-
59	14YRS	M	FAILURE IN EXAMS	RESIDENCE	COIR ROPE	PARTIAL	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	PRESENT ON RIGHT SIDE	ABSENT	-	-	-	-
60	19YRS	F	DOWRY HARRASMENT	RESIDENCE	NYLON SAREE	COMPLETE	BACK	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	PRESENT ON LEFT SIDE	-	-	-	-
61	30YRS	M	MARITAL DISHARMONY	RESIDENCE	NYLON ROPE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-

62	59YRS	F	FAMILY PROBLEM, DEPRESSED	RESIDENCE	NYLON SAREE	COMPLETE	LEFT SIDE	BROUGHT DEAD	ABOVE THYROID CARTILAGE	ABSENT	PRESENT ON RIGHT SIDE	-	-	-	-
63	32YRS	M	MARITAL DISHARMONY	RESIDENCE	COTTON LUNGI	PARTIAL	LEFT SIDE	BROUGHT DEAD	OVER AND ABOVE THYROID CARTILAGE	ABSENT	ABSENT	-	-	-	-